GENERAL LIBRARY Engineering Library
JUL 21 1920
UNIV. OF MICH.

to Civil Engineering and Contracting

McGRAW-HILL COMPANY, INC.

July 22, 1920

Engineering News-Record

Leading Technical Articles

Opinions on Proposed Staten Island Piers by Leading Port Engineers

The Depreciation Allowance
By Dean W. G. Raymond

Chart Records of Excavating Machine Operation

Special Impellers for Dredging Stumpy Ground
By Walter J. White

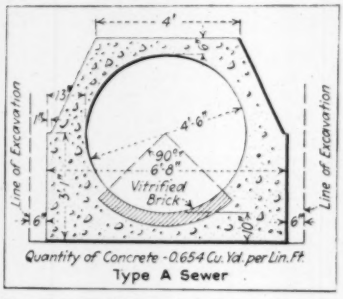
A Dozen Articles for the "Average Engineer"

To present an adequate record of civil engineering and construction progress *Engineering News-Record* must necessarily devote considerable space to the large, important and costly projects. Occasionally, however, a reader writes to us in these words:

"Many of us are just 'average engineers.' The big jobs like the New York subways, the Panama Canal, the Los Angeles Aqueduct, or the Quebec Bridge are of general interest, but in them we do not always find details of design or construction directly applicable to our own work. We deal with the smaller undertakings and must think in terms of thousands of dollars instead of in millions. Can we not have a few short articles dealing with the work that the 'average engineer' has to do?"

In response to a number of requests of this sort the editors have included in this issue about a dozen short articles—none of them dealing with extraordinary or costly work—for the "average engineer."

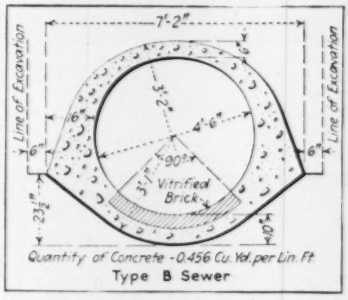
Two Sewer Cross Sections and a $1000 Saving



Here are alternate sections of a sewer at Lynn, Mass., on which contractors were asked to bid. When the unit prices had been examined it was found that the section with the *largest concrete yardage* per foot could actually be constructed at the *lowest cost.*

This interesting case of how fore-thought on the part of the consulting engineers effected a substantial saving on a small job is discussed in this issue

By John P. Wentworth
Assistant Engineer with Metcalf & Eddy, Consulting Engineers, Boston



Other "Average Engineer" Articles

Simple Scheme of Indexing Notes and Plans
By F. Deane Avery

Load Tests of End Joints in Maple Flooring
By C. A. Petry

Accounting System for a Small Engineering Office
By G. N. Pfeiffer

Rapid Progress on Topographic Surveys
By R. H. Randall

Practical Method of Applying Stadia Constants
By W. J. Nuebling

Computing Cross Sectional Areas
By J. A. MacDonald

Anti-Slip Spring for Level Rod
By J. O. Cook

Storm-Water Run-off Diagram
By G. C. D. Lenth

Conversion Table, Stations to Miles
By R. T. Brown

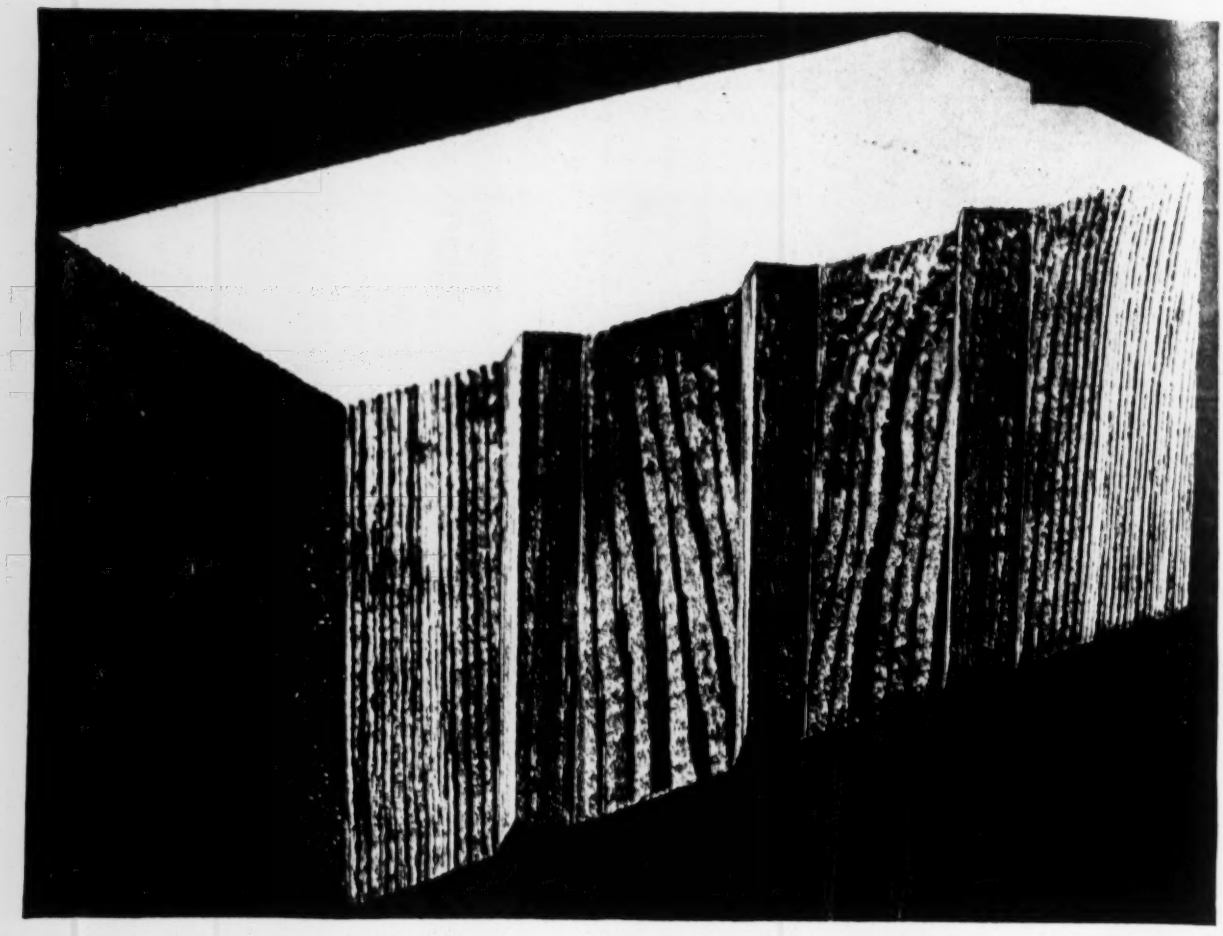
Tables Giving Weight of Rail in Tons
By G. W. White

Template for Given Degree Curve to Any Scale
By D. P. Maxwell

Estimating Conduit Capacity in Relation to Storage
By F. H. Hapgood

Rapid Determination of Rivet Pitch in Plate Girders
By R. Smillie

KREOLITE WOOD BLOCK FLOOR



Patented May 13, 1913, May 6, 1919

Outlast the Factory

WHEN Industry has a belief in the worth of a product, it speaks in no uncertain terms—its appreciation is best shown by repeat orders.

The following list of prominent users of Kreolite Floors amounts to a vote of confidence on the part of American Industry.

The list contains only the names of manufacturers who have placed ten or more repeat orders. It is a record that speaks for itself.

Kreolite Floors are more than a satisfactory floor surface—they represent a *factory floor service*.

Behind them is an organization of specialists devoted to the solving of floor problems.

List of Concerns Which have Placed Ten or More Repeat Orders for Kreolite Floors

	No. of Repeat Orders	*Square Feet*
The Pennsylvania R. R. Company	40	605,223
The Ford Motor Company	35	720,972
The General Electric Company	28	539,568
The Buick Motor Company	23	337,842
The Bethlehem Steel Company	19	246,831
The B. F. Goodrich Company	18	194,040
The Willys-Overland Co.	17	117,666
The Westinghouse Air Brake Co.	14	81,270
The American Radiator Company	14	58,014
The Reo Motor Company	13	157,612
The U. S. Malleable Iron Company	13	14,040
The National Enam. & Stamping Co.	12	196,848
The Timken-Detroit Axle Co.	12	67,086
The Du Pont de Nemours Powder Co.	11	26,109
The Standard Steel Tube Co.	11	56,207
The Dunkenheimer Company	10	65,710
The Olds Motor Company	10	376,180
The United States Aluminum Co.	10	220,510
The American Locomotive Company	10	219,654

Our Engineering Department is placed unreservedly at the disposal of manufacturers seeking to solve floor difficulties.

We also send competent, reliable men to superintend their proper installation.

Kreolite Floors are especially adapted for machine shops, foundries, paper mills, loading platforms, area ways, roundhouses, stables, etc.

Our book on factory floors tells of the special treatment of the blocks; their grooved construction which gives unit-strength.

Send for this book or call upon the services of our Factory Floor Engineers without obligation.

Address the Toledo Office.

The Jennison-Wright Company, 79 Kreolite Building, Toledo, Ohio

Branches: Albany, Chicago, Boston, Philadelphia, St. Louis, Pittsburgh, Cleveland, Detroit, Toronto, and other principal cities
British Distributors—Anglo-American Agency, Royal Liver Bldg., Liverpool, England

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 85 — NEW YORK, THURSDAY, JULY 22, 1920 — Number 4

Selectmen-Manager Plan

THE adaptability of the manager plan of government to almost any local condition is in a way of being demonstrated at Mansfield, Mass. There, on July 12, a good old-fashioned town meeting voted 505 to 55 for a selectmen-manager plan of government. Five selectmen, elected yearly and serving without pay, will employ and direct a town manager. This democratic-representative-business form of government may shock the author of "Back to the Republic" (p. 133 of our issue of July 15), judging from his sweeping condemnation of the city manager plan. But in spirit it squares with the American constitution and with Mills' "Representative Government" in that the voters at large do not try to pick out administrative heads whose success in office depends upon technical ability. Instead they select men to do it for them.

Articles for the "Average Engineer"

A WIDE range of subjects is covered by the dozen articles for the "average engineer" published in this issue. All are short—averaging only slightly more than a column in length—and discuss both from the point of view of the designer and the constructor the problems encountered in the comparatively small engineering office or drafting room. That there is a demand for material of this sort has always been recognized by this journal. In fact similar articles are presented in practically every issue. This week, however, the space devoted to small job details has been increased and the articles have been grouped under a general heading. It is hoped by giving prominence to concise accounts of interesting details, as contrasted with longer descriptions of larger projects, that readers may be induced to contribute from the fund of their experience matter relating to the "kinks" or time-saving methods or devices which, taken in the aggregate, are a big factor in simplifying routine work, but which are not always considered, especially by those who use them, to be of sufficient importance to warrant description in a technical journal. It is only a comparatively small proportion of the engineering profession which is called upon to handle works the size of the Panama Canal or the Quebec Bridge. From the editorial standpoint the presentation of detailed articles on such projects is not difficult. This is not the case, however, with the small job. There is a real need for the exchange of information among "average engineers" on the everyday details of their work.

Holes in Concrete Hulls

IT HAS been proved in numerous cases that holes in the hulls of concrete ships can be repaired in a very short time and at a trifling expense compared to similar repairs in steel ships. There are those who would advance this as an argument in favor of concrete for ships, but in fact back of it lies one of the most serious criticisms of this new type of ship construction. Concrete hulls are altogether too easily broken. Barges and ships alike are continually coming into dock for repairs. Blows that come as a part of the daily routine of a steel or wood boat result in shattered shells or more probably punched holes in the concrete vessel. The ease of repair is quite counterbalanced by the frequent necessity for such repair. Much of this weakness against punching is probably due to the peculiar nature of ship concrete which, with its rich mix and closely spaced steel, is a different material from ordinary building concrete. Then, too, no land structure is ever subjected to the tremendous inertia exerted by the heavy mass of a ship, be it moving ever so slowly, so that experience on land is a poor guide to the probable behavior of a ship's hull under impact, and any experiments which could be devised would be only faintly comparative. These, however, are conjectural matters; what is certain is that this tendency to punch is easily the most serious structural defect in the concrete ship as demonstrated in service, though in the preliminary studies and design it was subordinated to many other considerations which have given no concern in the finished ship.

A Sewage Farming Possibility

LOS ANGELES has a possible opportunity to increase its fame and growth by an engineering enterprise that would rival the great aqueduct and man-made harbor of which it is rightly so proud. The water brought from the high Sierras by the aqueduct is already used for power on its way to the city and again for domestic and irrigation purposes. Why not make the water do triple duty by utilizing the sewage of the city for irrigation? The question has recently been under discussion by some of the city officials. Vast quantities of spent water from the aqueduct now flow uselessly to the Pacific—worse than uselessly, beach cities near the aqueduct complain. In a land of little rain it is an economic sin not to utilize sewage for irrigation if a practicable plan to do so can be devised. Outlets for sewage utilization were provided when the outfall sewer to the ocean was built. In fact some of the sewage of Los Angeles was used for irrigation in years gone by. The practice was discontinued because the districts in which the sewage was utilized became filled with houses and also because of opposition by physicians and others who claimed that the garden produce from the sewage-irrigated land was a menace to health. More recent methods of sewage treatment are now available. Land clogging and nuisance could be controlled by removing as much as need be of the organic and other solids from the sewage before it was used for irrigation and chlorination could be employed to disinfect the applied sewage. The activated-sludge process for both nuisance prevention and bacterial reduction might be worth looking into, particularly if there were promise of converting the sludge into fertilizer. If disinfection were still

thought to be necessary or desirable for safety presumably but a light dose of chlorine would be needed. In studies of sewage utilization at Los Angeles consideration would properly be given to the fact that as the rural areas now irrigated by the surplus waters of the aqueduct are given over to houses the waste water going to the sewers will be increased correspondingly, while at the same time the area of truck and fruit land in and near Los Angeles will decrease. The subject is a fascinating one. Light upon it close at hand is available in the working experience of the Pasadena sewage farm and in the activated-sludge experiments and other studies conducted for Pasadena, South Pasadena and Alhambra.

Engineers Favor Wide Piers

IS PRESENT profit or future progress the proper guide to a city's port policy? That is the question raised by New York's new Staten Island pier development. By precept and practice the city administration holds to the former. The weight of engineering opinion is for the latter. No better example can be found of the common conflict between the political and the engineering view.

The city enters its steamship piers in its books as a separate account; so much expended, so much earned. If the latter is a fair percentage of the former, it is satisfied. The engineer sees New York as the greatest port in the world, dominant partly because of its natural location, partly because of its provided facilities, but mainly because it is the tonnage market and the financial center of the country. He sees the business which must inevitably come here hampered by an unwieldy transfer system and the excessive burden of cost shifted onto the consuming public everywhere. The immediate return to the city treasury seems to him to be insignificant compared to the economic waste the present policy condones.

The Stapleton pier project is only a minor part of the problem, and is interesting because it exhibits at this particular time the city's disregard of the broad principles of port layout. It is symtomatic of the administration's attitude toward a development of New York as an economic factor in the business of the whole country; their shortsighted view of the city's own welfare is a matter for consideration by the citizens of New York themselves.

No one can escape the weight of the engineering opinion expressed in the symposium on the Stapleton development on another page of this issue. These men are experts and unprejudiced; there can be no possibility of collusion. Yet every one in set terms condemns the design and layout as being archaic and uneconomical. The issue is clear. For piers of a length of those on Staten Island, a maximum of movement—and consequently a maximum of economy—demands a pier wide enough to hold the contents of the vessels which can tie up to it and a machinery equipment sufficient to move those contents off the pier in the time that another ship is discharging. The alternative of a narrow pier requires either long storage on lighters or railway cars, or longer turnaround for the ship, both of which mean increased cost of handling goods. That present practice in New York permits the steamship companies to shift these excess costs off onto someone else is a poor argument in favor of permitting them to continue to do so.

There is a great deal of loose talk today regardi mechanical freight handling on piers. The fact is th with few exceptions the perfectly equipped piers of t country have never had enough business to demonstrat their superiority. Railway track on piers may or m not work better than tracks to the doors of the pie with tractor-trailer transport into the shed and to t ship's side. For some conditions elaborate machine only adds to first costs and maintenance without co pensating economies. But the necessity for room on th piers is obvious. Terminal operation is a traffic matter pure and simple. Material must be gotten out of the wa so as to permit other material to take its place, and th flow must be uninterrupted. This can be accomplished by rapid handling, but this presupposes machine-like operation of the whole chain of movements and can be wrecked by human frailty. As a safety valve—or to change the metaphor, a reservoir—there must be provided plenty of room so that if the through progress of movement is interrupted there is always space in which to deposit the held up freight. This the Stapleton design does not provide and on this ground more than any other it must be criticised. Railroad connections and handling machinery might conceivably be added; space cannot except at the expense of the slips, which is only robbing Peter to pay Paul.

Co-operation of Material Interests

THE truly successful engineer or architect utilizes a certain material or combination of materials only after making a close analysis of service, cost and desirability. For many years the profession has seen material interests fight each other uncompromisingly in efforts to secure exclusive use of their particular products. Some anomalous and peculiar conditions have arisen, hard at times to explain to the layman. Brick streets in the past have been largely promoted by filler makers. The cement and brick interests have always been bitter competitors, although the best specifications for a brick pavement call for a concrete foundation. The broken-stone interests have advocated macadam regardless of service required, with disastrous consequences, seemingly overlooking the fact that broken stone in great quantities is needed for aggregate in concrete pavements and for foundations of both brick and asphalt pavements.

Several years ago a non-knocking policy was adopted by one of the strongest material associations. It recognized that the best results for all concerned are obtained only when a true analysis of service requirements has been made by the engineer and the material thus indicated is used to meet that service. Its mission was largely to help the engineer learn of the merits of its product and not of the demerits of competing materials. Co-operation between competing materials should give the engineer and builder more nearly what he needs.

Metal lath, formerly bitterly opposed by the lumber interests, is now advocated by a few of them for vulnerable parts of timber buildings. This promulgation will increase the legitimate sales of metal lath and reduce but slightly the aggregate sale of lumber, but it will render the whole structure much more fire-resistive and in this way give frame buildings a better reputation. Both producers and consumers will profit by the co-operative effort. Opportunities for similar co-operative effort should be looked for and seized.

Public Works and City Integration

GREAT quickening of the flow of traffic between the North Side and the business district of Chicago has resulted from the opening of the new Michigan Boulevard river crossing. A continuous, broad and direct route across the river is available in place of a traffic-congested bottle-neck in a main thoroughfare having extremely heavy automobile traffic. It is plain to all that the improvement constitutes a noteworthy public benefit of general effect upon the city, not a mere local convenience. The gain through creation of an unobstructed through route, with its incidental separation of fast and slow traffic by two decks, is something not to be measured by increase in the numbers transported across the river, or by potential toll receipts. The many thousands of hours of time saved each day mean a more thorough integration of the community.

Similar advantage to the public is realized from all city works that level barriers to free intercommunication. It is apt to constitute the principal element of value in such an improvement, and should be taken account of specifically in the engineering calculations on which the project is based. Consideration is given to this factor—it may properly be called the city integration factor—in the planning of street widenings, or new streets to be cut through districts that obstruct active traffic flows. But the case is otherwise when a bridge, a valley viaduct, a tunnel or the like is in question. The probable value of the work is often gaged mainly or wholly by the traffic it will carry, and the revenue which might be derived from this traffic when rated at a reasonable toll is taken to represent the gross earning value of the improvement. Yet in most cases such income calculation is a very incomplete estimate of service value since it ignores the distributed gain to the community resulting from integration of its separated areas. Failure to include this latter element of value in determining on the justification for a given city improvement may operate to condemn or delay an enterprise that the city sorely needs.

We refer to city work because a broader view prevails in the planning of highway improvements in the open country. When an improved road connection is under consideration deliberate allowance is made for the distributed benefits resulting from community integration. This allowance, it is conceded, is not quantitatively precise, yet it receives a primary place in deciding upon the justification of the project. Perhaps the relatively large areas and scattered populations involved make the remoter influences of improving a communication route more obvious than under the localized conditions affecting a city government. Possibly it is true also that the political methods by which most highway improvements are directed give better expression to the requirements of scattered parts of the area served, and thereby bring the element of community integration to the foreground of the question in a manner not found in the case of city enterprises. At any rate, experience shows that most city public works are entered upon without a live, forceful appreciation of their distributive value to the community.

Traffic and toll data for a bridge project or the like are easily expressed in figures, and the figures give an air of definiteness to the advance estimates. Not so in the matter of the more elusive effects of the enterprise on the efficiency of the community as a whole. The engineer may well feel disinclined to deal quantitatively with the great variety of minute scattered benefits accruing to the community from the more thorough knitting together that is to result from his project; and argument expressed generalities is often deceptive. But if he ignores the integrating effect he also misses a potent inspiration and may err seriously in his deductions.

Deliberate effort to grasp the specific meaning of community integration in the particular case before him is a necessary preliminary to the engineer's choice of a method of expressing the effect quantitatively in figures. But such a method should always be discoverable, and with the help of its results he can base his project on a true showing of costs and earnings. Unless he does this his recommendations are almost certain to be over-conservative, and time and again he will see his figures outweighed by the convincing appeal of some promoter, whose broader vision looks beyond the limited scope of the engineer's traffic estimates.

It is not only the engineer that is at fault, for the public at large also tends to ignore or undervalue the broader effect. Thus, were the value of community integration fully appreciated within the New York metropolitan territory we have no doubt that three or four vehicle tunnels under the Hudson River might now be building instead of one, or possibly a great bridge, to bind together the western industrial section of New York City and its central portion. Again, if the citizens of Cleveland gave full weight to similar integrating effects they might before this have forced construction of the new Cuyahoga Valley viaduct at Huron Road, an enterprise which has been deferred and delayed for several years and has left the city with but a single thoroughfare to its great undeveloped west side. In both cases engineers appreciate the situation in a general way, but the public does not. Engineers are not sufficiently impressed with the importance of the integration factor to compel its recognition by the people; otherwise they would be able to find means for expressing the probable effect in terms of figures and bring the dominant argument before the public consciousness in a compelling way. Because of their failure to do this many projects that are urgently required for the better service of the community are placed in an unfavorable light and must undergo a long postponement.

Traffic-improvement projects or works already under construction in many cities give equal opportunity for considering the relation of public works to integration of city areas. The Philadelphia-Camden bridge, the Second St. tunnel in Los Angeles, the Liberty tunnel or the proposed McKees Rocks bridge in Pittsburgh, the Ogden Ave. extension and street widenings at Chicago and other enterprises might be cited. With few exceptions all cities have problems of overcoming natural or artificial barriers to free communication, which cut the urban area into separate parts and throttle or inhibit traffic between them. And there are not a few cases in which the sections thus cut apart are so remote from each other in a traffic sense as to be virtually distinct communities without effective commercial intercourse. Whether the barrier be river or hillside or railroad right-of-way or gorge, so soon as the city cuts through it with thoroughfares the separated parts become one, and the community increases its activity and production far more than by mere addition. Of this integration, brought about by engineering works, engineers should prove the most competent advocates.

A Dozen Articles for the "Average Engineer"

EDITOR'S NOTE—*As noted on the front cover, this issue contains more than the usual number of articles for the "average engineer"—the man who is concerned not so much with large or costly works like the Miami Districts' flood protection works, the Hell Gate Bridge or the Catskill Aqueduct, but rather with details of design and construction and the daily routine encountered in the smaller engineering or contracting organization.* ENGINEERING NEWS-RECORD *must give adequate treatment to the big projects, but at the same time it recognizes the needs of the "average engineer" and endeavors to give him the kind of material which he will find useful in his own work.*

Every now and then we receive a letter from one of our readers suggesting that more space in the paper be devoted to small job articles. Good material of this sort is not easy to secure. Many men, apparently, feel a certain hesitancy in sending articles to the technical press unless they deal with work the cost of which runs well into six figures. It is true that much of the small work is commonplace, but it frequently develops one or more details of striking interest. A case in point is that of the alternate sewer sections at Lynn, Mass., described by Mr. Wentworth on this page. If our friends who urge the publication of more material for the "average engineer" would tell us briefly how some one feature of their own work was handled in an effective or novel way, or how some useful, time-saving kink was developed in the drafting-room or in the field, it would be easier for the editors of this journal to publish a greater volume of material for the "average engineer."

Sewer Cost Lowered by Increasing Concrete Yardage in Section

Simplification of Form Work at Lynn, Mass., Cuts Contractor's Bid $2 per Linear Foot and Saves $1,000

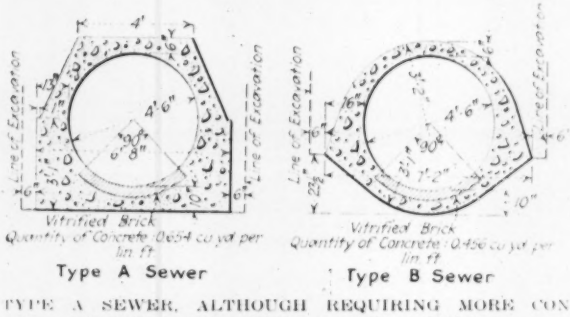
BY JOHN P. WENTWORTH
Assistant Engineer, Metcalf & Eddy, Consulting Engineers, Boston, Mass.

THE lowest bid received on June 15, at Lynn, Mass. for a concrete sewer affords an opportunity to secure a contractor's views upon the cost of furnishing and placing concrete in a section accurately proportioned to meet loading and other conditions, and in another section adequate for the same conditions but more generously proportioned and for which curved outside forms or "jackets" are not required. The contract drawings showed two-cross sections, Types A and B, either of which was acceptable. The object of offering two types was to give an opportunity for the city to adopt the cheaper section.

As shown by the accompanying drawing, Type A requires a flat bottom, whereas Type B requires a curved trench bottom. In the case of Type A, below the springing line, the contractor will be permitted to place the concrete directly against the sides of the trench, if in firm ground, otherwise he must use outside forms or place the concrete against the sheeting. If the concrete is placed against the sheeting the contractor must either draw the sheeting, or leave it in at his own expense. Above the springing line he must use outside forms, but as these will be plane surfaces no shop work will be required.

In the case of Type B, outside forms will be necessary from bottom to top. These forms will be curved, requiring a small amount of shopwork for getting out the ribs.

In each case the quantity of excavation to be paid for will be computed to lines of excavation 6 in. outside the concrete. In the case of Type A, however, the contractor, if he chooses, may excavate his trench 12 in. narrower than indicated by the "lines of excavation" and thus save about 0.5 cu.yd. of excavation per linear foot of trench. This cannot be done in the case of Type B because of the space required for the outside forms, although possibly some saving might be made by very careful and well planned work. Furthermore, the narrower trench for Type A will simplify and cheapen the cost of bracing.


Line of Excavation
Vitrified Brick
Quantity of Concrete 0.654 cu yd per lin ft
Type A Sewer
Line of Excavation
Vitrified Brick
Quantity of Concrete 0.456 cu yd per lin ft
Type B Sewer

TYPE A SEWER, ALTHOUGH REQUIRING MORE CONCRETE, DREW LOWER BID THAN TYPE B

The prices bid for concrete in the two cases are as follows: Type A, $25 per cu.yd.; Type B, $40 per cu.yd.

These prices are for 1:2:4 concrete; the contractor furnishes the cement. For a short length of the sewer steel reinforcement is required, but the contractor receives an extra price for furnishing and placing the steel.

The resulting costs per linear foot of sewer for concrete are: Type A, $16.35; Type B, $18.24.

The total difference in cost of concrete for the entire sewer (650 ft. of two sizes) is $1,000 in favor of Type A. The quantity of earth excavation paid for in the case of Type A sewer is slightly greater than in the case of Type B, so that the difference in cost in favor of Type A will be offset to the extent of $400, thus reducing the net difference to $600 in favor of Type A.

Among the possible reasons for the lower bid in the case of Type A the following have occurred to the writer:

(1) It affords opportunity for material saving in cost of excavation and bracing.

(2) It saves time in shaping the bottom of the trench.

(3) It permits the omission of lower outside forms.

(4) It avoids the use of curved outside forms.

(5) It permits of using cheaper labor for placing forms.

(6) It reduces time required for placing forms.

The proposal upon which this article is based may be fairly represent the general opinion of contractors, although it is in line with contractors' comments which have come to the notice of the writer on a number of occasions.

This sewer is to be built under the direction of William L. Vennard, city engineer of Lynn, Mass., Metcalf & Eddy acting as consulting engineers. The contract has been awarded to Anthony Baruffaldi of Somerville, Mass.

Load Tests of End Joints in Maple Flooring

By C. A. Petry

Structural Engineer, University of Illinois, Urbana

THE strength of the joints of dressed and matched flooring is seldom a factor in determining the type of flooring to be used. However, when a single-ply floor is considered which may be subjected to occasional heavy loads, information on the strength of the joints is essential. Some limited data were obtained recently from a test of this kind made by the Materials Testing Laboratory of the University of Illinois, at the request of the Supervising Architect's office of the university.

Two panels of ¹³⁄₁₆-in. maple flooring nailed to transverse sleepers were made up with sleepers spaced respectively 12 in. and 16 in. on centers; end joists were located as shown in Fig. 1. Load was applied to the specimens near transverse joints as shown. As the investigation was for the purpose of determining the effect of the weight of a grand piano, the load was applied by a steel cylinder approximately the size of a piano caster, and deflection readings taken.

At the left in Fig. 2 is a graphical representation of the relation of the deflection to the load; the maximum loads are noted. No attempt was made to secure deflection readings when nearing the ultimate load. The fracture was in most cases in the floor strip itself, not in the tongue. The toughness and elasticity of maple was strikingly demonstrated in the large deflections obtained before failure; in some instances the strip sprang back to its original position when the load was removed, after rupture.

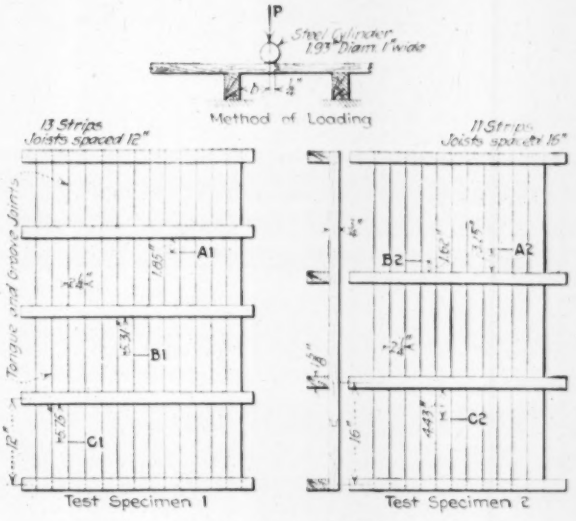


FIG. 1. MAPLE FLOOR PANELS FOR TEST

The curves at the right in Fig. 2 give the relation between the maximum load and the distance of the load to the near edge of the support. The few points obtained indicate the relation to be represented by a straight line.

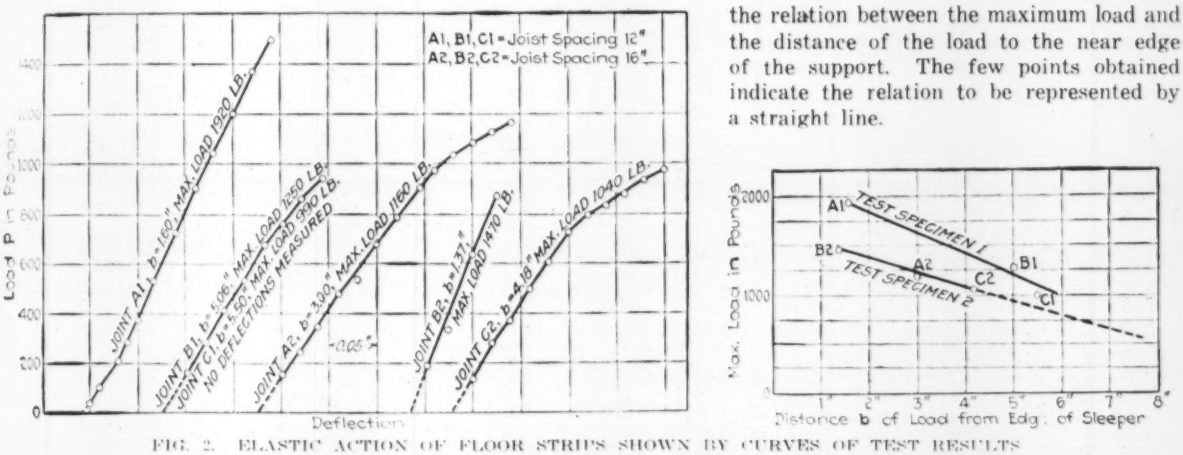

A1, B1, C1 = Joist Spacing 12"
A2, B2, C2 = Joist Spacing 16"
JOINT A1, b = 1.60", MAX. LOAD 1920 LB.
JOINT B1, b = 5.06", MAX. LOAD 1550 LB.
JOINT C1, b = 4.50", MAX. LOAD 1340 LB.
NO DEFLECTIONS MEASURED
JOINT A2, b = 3.00", MAX. LOAD 1160 LB.
JOINT B2, b = 1.37", MAX. LOAD 470 LB.
JOINT C2, b = 4.18", MAX. LOAD 1040 LB.
.005"
Load P in Pounds
Deflection
Max. Load in Pounds
TEST SPECIMEN 1
TEST SPECIMEN 2
Distance b of Load from Edg. of Sleeper

FIG. 2. ELASTIC ACTION OF FLOOR STRIPS SHOWN BY CURVES OF TEST RESULTS

Electrolytic Iron for Engineering Purposes

Studies of defects in electro-deposited iron carried out by W. E. Hughes and reported in a paper before the Iron and Steel Institute at its annual meeting on May 6, 1920, show that extensive structural irregularity, presence of pinholes, inclusion of foreign matter, and cracking or seaminess may occur in iron galvanically deposited. During the war, electrolytic iron was used in many instances for repair purposes and in parts for airplanes. Mr. Hughes concludes from his studies that the defects of electrolytic iron may render its use dangerous in engineering service unless it is heat-treated, but that these defects can be largely eliminated by skill in the deposition process. He also says that the common view that electrolytic iron is hard and brittle may need revision, as he has found such iron in many cases to be quite malleable.

The quantity of stone sold in the United States in 1919, according to a recent bulletin published by the U. S. Geological Survey, amounted to 71,380,000 tons.

Rapid Progress Made on Topographic Survey

Plane Table Party of Three Men Located 871 Shots in 7 Hr. 50 Min. for Topographic Map of Akron

By R. H. Randall
R. H. Randall & Co., Topographic Engineers, Toledo, Ohio

IN the making of a topographic survey of the City of Akron, Ohio, an incident occurred recently which may be of interest and worthy of record. A plane table party composed of three men located 871 shots in 7 hr. and 50 min., and upon these as control constructed a complete map, covering 75 acres, on a scale of 1:2400 and with a contour interval of 1 and 2 ft., the latter varying with the steepness of the slope. This map shows street lines and the outlines of wooded areas in addition to the topography. G. D. Whitmore, of this company, was the topographer in charge of the party.

These figures may not seem remarkable to the casual observer, but to the engineer familiar with field procedure in this work they are significant. They are evidence, upon the part of the topographer, of unusual efficiency in the handling of the instrument and of extreme rapidity and sureness in plotting and contour sketching. They further indicate an almost balance of effort of each man in the party with every other man; for to attain such speed the party chief must so direct the labors of himself and party that each man may be busy all the time with the thing that will most advance progress, and no man may be kept waiting and idle until another's work is completed.

Equipment Used

The instrumental equipment used by this party consisted of a regular Bausch & Lomb plane table outfit, the tripod having the Johnson movement, a 12-ft. rod having for a face a Keuffel & Esser flexible rod No. 6,332, a stadia slide rule, tape, etc.

On this day's work, as is customary when working upon this scale, distances were read and plotted to the nearest foot, elevations on side shots were read to tenths, and vertical angles to minutes. Elevations on turning points were read to hundredths of a foot. In reading vertical angles it is, of course, necessary to read an index or level angle. Thus the topographer for a level shot observes the level reading upon the rod, the stadia distance, plots the position of the new point, and writes the elevation to the nearest tenth upon the sheet, the recorder meanwhile giving him the plotting distance corrected for stadia factor and the computed elevation. For an angle shot the reading of "point sighted" and a "level angle" with the consequent increase in computation is added to this procedure.

As a basis of comparison it may be stated that the field records of the survey of Flint, Mich., (see *Engineering News-Record* of April 8, 1920, p. 700) show that an average day's field work for an experienced topographer runs from 200 to 500 shots, depending upon the type of country encountered and the efficiency of the topographer and the party as a whole. The previous high mark of which this company has record was made by C. S. Elicker in 1917. Upon the same scale and with the same size party as described here, 626 shots were read in 8 hours, controlling about 30 acres of extremely detailed, glacial topography near Jackson, Mich.

A Dozen Articles fo

To read a total of 871 shots in the 7 hr. and 50 mi Mr. Whitmore averaged a trifle better than 108 shot per hour. In one period of 20 min. he read and plotte a total of 75 shots. At another instrument station th total time elapsed was 18 min., during which time 1 shots were read and plotted and the contours complete sketched. The cost per square mile, as computed fro this day's work, would be about $159 for the map com plete in pencil. This of course includes no allowance for primary control or overhead charges. The accurac of this topographer's work has been amply proven by various test profiles, similar to that described in *Engineering News-Record* of April 8.

Other Records

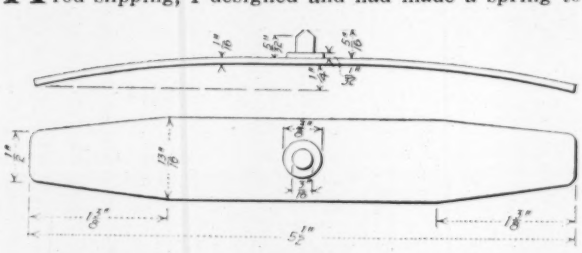
It might be pertinent here to call attention to other remarkable records published in *Engineering Record* of June 6, p. 639, July 18, p. 84, and Oct. 10, p. 415, 1914, which at the time occasioned some discussion. The best day's work recorded was 1,023 shots, using a transit party of 5 men. The best hour's work, with the same party was 212 shots.

At the risk of being considered controversial and of reopening an old discussion, the writer cannot resist comparing the relative advantages of the plane table and transit methods. The essence of the plane table method, as distinguished from the transit, is the obtaining of direction by direct sighting and the sketching of the topographic details in the field. In all classes of work and under all ordinary conditions, the plane table equals the transit. In all except three specific classes of work the plane table patently excels any other topographic method of making accurate, large-scale maps, *when in the hands of a competent, experienced operator.* A plane-table topographer to a certain extent must be "born." Given certain natural qualifications his subsequent training must be long and thorough. When finally proficient, he is able to make a better map, and with a smaller expenditure of effort, than it is possible to obtain by any other method. It is the purpose of this article to show some of the things it is possible for him to do.

Anti-Slip Spring for Level Rod

By John Orth Cook
Engineer, Allegheny County (Pa.) Planning Commission

HAVING had considerable trouble with my high level-rod slipping, I designed and had made a spring to



SPRING TO PREVENT SLIPPING OF LEVEL ROD

replace that furnished by the makers. The accompanying drawing is submitted for the benefit of other engineers who meet with the same difficulty.

the "Average Engineer"

Storm Water Run-Off Diagram for Rational Method

By George C. D. Lenth
Assistant Chief Sewer Engineer, City of Chicago

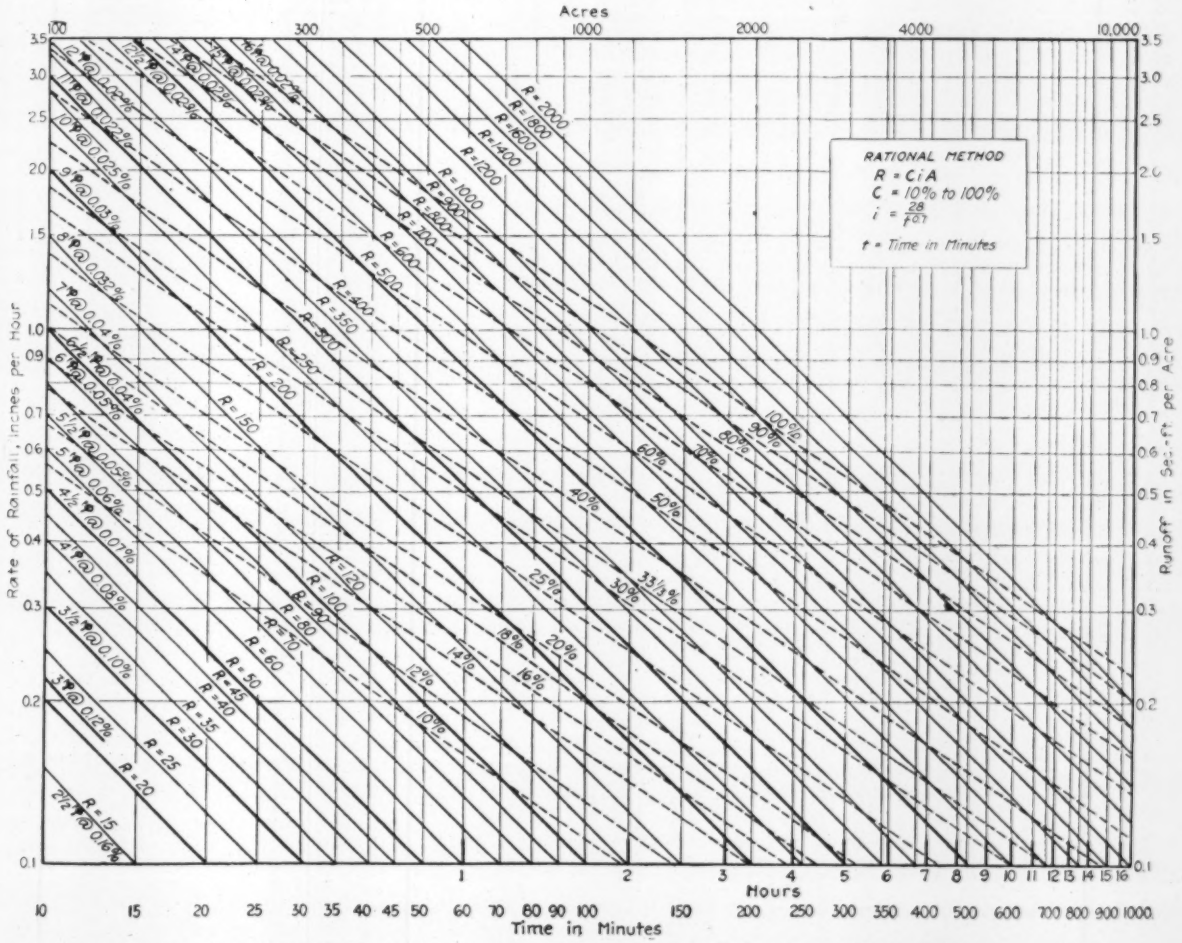
THE calculations of run-off by use of the rational method in the design of storm water sewers is somewhat tedious. With the idea of eliminating the labor of multiplication in solving this problem, the diagram herewith was made to give the run-off of a given area in second-feet, when the time of concentration, the area, and the ratio of run-off to rainfall has been determined. The volume of the storm water as determined by the rational method is dependent upon the intensity of rainfall, the duration of the storm and the character, slope and area of the drainage district under consideration.

The relation between intensity of precipitation and duration of the storm has been established for Chicago by the formula $i = 28/t^{0.7}$. The time "t" in minutes is the time required for the water to reach the sewer, known as the inlet time, plus the time due to the storage capacity of the sewer, plus the time of flow from the most distant point to the point under consideration, which is usually taken as the time of concentration. The coefficient to run-off, or the run-off factor, may vary from 100 per cent to 10 per cent, in accordance with the judgment of the designing engineer. It is predicated upon the character, the surface of the drainage area as regards imperviousness and slope.

Referring to the diagram, the rate of rainfall in inches per hour and the corresponding rate of run-off in second-feet per acre is platted vertically on a logarithmic scale and indicated along the right and left margins. The time in minutes is platted logarithmically and indicated along the upper and lower margins. The dotted diagonal lines indicate the intensity of rainfall corresponding to the time of concentration affected by coefficients of run-off varying from 10 per cent to 100 per cent, so that for a given time by means of the diagram the rate of run-off is obtainable.

Imposed upon the diagram is a second series of full diagonal lines indicating the total run-off in second-feet from any area indicated in acres along the lower margin with any rate of run-off indicated on the side margin. At the upper ends of the diagonal lines are indicated the size of circular sewers that would have the required capacity when flowing full at a velocity of approximately 3 ft. per second.

To illustrate the use of the diagram, let it be assumed that the drainage area is 500 acres, that the inlet time is 15 minutes, that the time of flow in the sewer 50



RATIONAL METHOD DIAGRAM FOR STORM WATER RUN-OFF AS USED IN CHICAGO

minutes, and the time due to storage capacity 25 minutes, so that the total time will be 90 minutes. The character, slope and local conditions require a run-off of 25 per cent of the rainfall. Following the vertical line indicating "90 minutes" to the intersection of the dotted diagonal line showing the intensity of rainfall as 25 per cent, we find the rate of rainfall is at their intersection and read along the right margin, or 0.3 in. per hour, or 0.3 sec. ft. per acre. Passing along the horizontal line "0.3 in. per hour" to the vertical line indicating 500 acres, we find the full diagonal line marked 150 sec. ft.

Computing Cross-Section Areas by the Method of Co-ordinates

By J. A. MacDonald
Provincial Land Surveyor, Souris, Prince Edward Island

THE co-ordinate method of computing cross-section areas here described is little practised by engineers and surveyors for the very good reason that it is not taught in technical schools nor is it given in the manner here shown in textbooks. Something, after the manner of computing land areas by double meridian distances, is given in many textbooks, but this simple and concise method is considerably different and for rough and broken sections there is no other known method so simple.

The cross-section is considered an area all of whose co-ordinates are known. The cuts or fills are represented as ordinates and expressed in terms of y, while the distance out from the center becomes abscissæ, and are expressed in terms of x.

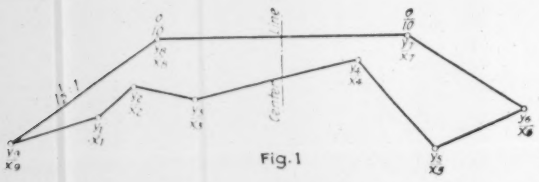


Fig. 1

The field notes of the section (Fig. 1), would be written thus: $\frac{-8}{22}\ \frac{-6}{15}\ \frac{-4}{12}\ \frac{-5}{7}\ \frac{-2}{6}\ \frac{-9}{12}\ \frac{-6}{19}$, the minus sign indicating a fill.

The general formula for any possible shape of cross-section whose area is A would be (Fig. 1) $y_1(x_9 - x_2) + y_2(x_1 - x_3) + y_3(x_2 - x_4) + y_4(x_3 - x_5) + y_5(x_4 - x_6) + y_6(x_5 - x_7) + y_7(x_6 - x_8) + y_8(x_7 - x_9)$.

The application of this formula is not at all as difficult as its formidable appearance would indicate to the reader.

In making use of this formula it will be advisable at first to draw a rough sketch of the section (Fig. 2) indicating the data from the field book in their proper positions.

A very little practice will enable the engineer to compute the areas directly from his cross-section notes. The formula is not an approximation as are the slope and other formulas, but is mathematically correct. Begin at any point on the section and proceed with the sun or hands of the watch, or counterwise, as one may elect, multiplying each cut or fill in its order by its horizontal distance between the point just preceding and the point just succeeding. In the above rough

sketch I begin at $\frac{y_1}{x_1}$ or $\frac{6}{15}$ and I multiply the ordinate y_1 or 6 by the horizontal distance between $\frac{8}{22}$ or [illegible] and $\frac{9}{12}$ or $\frac{y_2}{x_2}$ —the preceding and the succeeding. Thus

$y_1(x_9 - x_2)$	= 6 ×	10	=	60	
$y_2(x_1 - x_3)$	= 4 ×	8	=	32	
$y_3(x_2 - x_4)$	= 5 ×	18	=	90	
$y_4(x_3 - x_5)$	= 2 ×	19	=	38	
$y_5(x_4 - x_6)$	= 9 ×	13	=	117	
$y_6(x_5 - x_7)$	= 6 ×	2	=	...	—12
$y_7(x_6 - x_8)$	=	0	=	—	
$y_8(x_7 - x_9)$	=	0	=	—	
$y_9(x_8 - x_1)$	= 8 ×	5	=	...	—40
				337	—52

$$\frac{337 - 52}{2} = \frac{285}{2} = 142.5 \text{ sq.ft.}$$

In cases where one passes to the left (as I did at $\frac{6}{19}$ or $\frac{y_6}{x_6}$ in measuring the horizontal distance from the point just preceding to the point just succeeding, the product obtained by multiplying this distance by the cut or fill, at the intermediate point, is of one sign, and in cases where one passes to the right it is of the opposite sign.

Take one-half the difference between the sums of the products of opposite signs, and the result is the area of the section.

Thus in a side-cut where only the slope stake reading and the intersection of the earth surface with the grade-line are taken, the area is a simple triangle, and the application of the formula to the computation of the area would seem to require three multiplications. Two

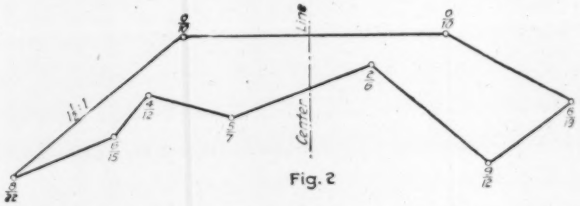


Fig. 2

of the points, however, are on the grade-line and the cut, or fill, is zero; hence the product is zero. The formula, therefore, results in a single multiplication and taking one-half the product of the fill (or cut) and width. In the "three level" case, two multiplications are eliminated. Many useful and interesting uses of the formula appear as its application is extended.

Shipping Board Has Nine Million Tons of Merchant Vessels

According to its latest statistical compilcation the U. S. Shipping Board owns and controls a total gross tonnage of vessels amounting to 9,243,464. This comprises 1493 ships, of which 1388 are cargo, 28 cargo and passenger, 59 tank, 15 refrigerator, and 3 transport vessels. About one-ninth of the total consists of wood, composite and concrete ships, including 271 wood and composite, of 997,854 tons, and 4 concrete, of 13,500 tons.

the "Average Engineer"

Estimation of Conduit Capacity in Relation to Storage

By Frederic H. Hapgood
With Hazen, Whipple & Fuller, Consulting Engineers, New York City

ONE of the problems encountered in connection with studies for a new water supply for New Britain, Conn., was finding the most economical combination of capacities of a retarding reservoir and a pipe line to provide a sufficiently complete development of the drainage area selected. The computations for this purpose here given were made by the writer in the office of Hazen, Whipple & Fuller, New York City.

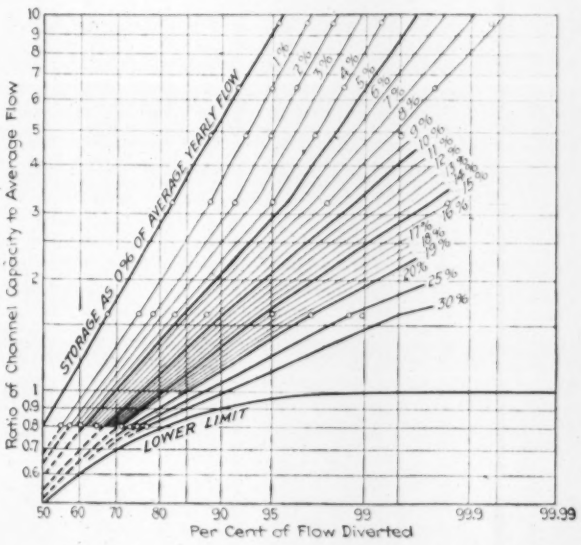
The areas from which it is proposed to take water to New Britain are about ten miles away. Upon investigation it was found that it would be impracticable to build a storage reservoir of sufficient size on the watersheds themselves, because at points where storage might be provided the extent and coarseness of the materials underneath the dam sites made a tight dam impracticable and at the point where it was practicable to build a fairly tight dam the contour of the country was such that sufficient storage could not be provided. Near the city, however, there is a favorable site for a sufficiently large storage reservoir. It would require too expensive a pipe line to bring the flood flows of the stream to the reservoir, but by providing a retarding reservoir at the inlet end of the pipe line a smaller pipe will serve. The larger the reservoir, the smaller the capacity of the pipe line may be.

Since the records of flow from the area covered too short a period, search was made for a reliable, long-term record taken on some similar area. The records of the daily flow of the Manhan River in Southampton, Mass., from 1897 to 1915 inclusive, started under the direction of James L. Tighe, formerly city engineer of Holyoke, Mass., were chosen. Therefore, the following calculations apply directly only to watersheds similar to that of the Manhan River.

The capacity of a diverting conduit depends upon three variables: (1) The size of the stream measured by its average annual flow; (2) the portion of the total flow of a stream that it is desired to divert, and (3) the size of the retarding reservoir that it is convenient to build at the inlet end of the conduit. The best method of finding out the relations existing between several variables is by means of a diagram, and consequently a diagram was constructed. Points on this diagram were found by computing the amount of water that would run to waste if an assumed rate of draft drew water from an assumed retarding reservoir that was being filled by the flows recorded for the Manhan River. The quantity of water diverted would be the difference between the total flow and this computed waste.

In these computations the following assumptions were made: (1) It was assumed that the conduit was always wide open. (2) The retarding reservoir was considered large enough to take care of the hourly fluctuations in flow. (3) If any water was left in the retarding reservoir at the end of the 19-year period, it was assumed that the period would repeat itself and the computations were continued by starting again with the earliest year, but with the reservoir containing the water left in it at the end of the last year, and by computing the amount wasted until the reservoir was emptied, thus starting and ending with an empty reservoir.

With these assumptions, computations of the amount of water that would run to waste were made for several rates of draft and for several sizes of retarding reservoir sufficient to cover the entire desired range. These computations were more tedious than difficult. For instance, take the lowest draft assumed, which was 1,000,000 gal. per day per square mile. To find the waste at this rate it was necessary to go through the records of each day's flow for the whole 19 years and set down the amount by which that day's flow exceeded or was less than 1,000,000 gal. The sum of all the excesses gave the waste if there were no storage. But, with a retarding reservoir of a certain size the first



RELATION BETWEEN CAPACITIES OF CONDUIT AND STORAGE RESERVOIR

water above the assumed 1,000,000-gal. draft was held until the pipe took it or until the retarding reservoir had been filled. After the retarding reservoir had been filled, if the flow continued above the pipe capacity the excesses mentioned above could be estimated as going to waste. When the flow became less than the 1,000,000-gal. draft, the reservoir would begin to empty and there would be no waste. In working out the waste at one rate of draft and with several assumed reservoir capacities, a table was arranged by which it was unnecessary to repeat the entire calculation and much repetition of work was avoided. The resulting quantities of waste were figured as percentages of the total flow for the whole period. The differences between these and 100 per cent gave the portions of the flow that could have been diverted.

By expressing conduit and reservoir capacities in terms of average flows, the results were reduced to a common basis and became generally applicable to similar watersheds. From these results the curves shown herewith were plotted. Logarithmic probability paper was used because the lines appear straighter on it than on any other. The line on the diagram labeled "lower limit" simply shows that where the conduit capacity is

less than the average flow of the stream it is impossible to divert the whole stream through that conduit, the largest amount of course being equal to the capacity of the conduit. As this approaches the average flow of the stream, the sizes of the retarding reservoir necessary to make diversion equal to conduit capacity becomes very large.

The following example will serve to show how the curves may be applied to watersheds similar to that of the Manhan River:

Suppose: Area of watershed, 2.5 sq.mi.; average flow, 455,770,000 gal. per sq.mi.; maximum storage that can be provided in diversion reservoir, 15,000,000 gal.; daily draft required, 2,500,000 gal.

$$\text{Maximum Storage} \quad 15{,}000{,}000 \text{ gal. or}$$

$$\frac{15{,}000{,}000}{2.5 \times 455{,}770{,}000}$$

1.32 per cent of average yearly flow.

$$\text{Average daily draft} = 2{,}500{,}000 \text{ gal. or}$$

$$\frac{2{,}500{,}000 \times 365}{2.5 \times 455{,}770{,}000}$$

80 per cent of flow to be diverted.

From the curves: To divert 80 per cent of the flow by the use of a diverting reservoir whose capacity is 1.32 per cent of the average yearly flow requires a diversion channel whose capacity is 1.9 times the average flow of the stream or

$$\frac{455{,}770{,}000}{1.9 \times 365 \times 24 \times 60 \times 60 \times 7.48} = 3.68 \text{ cu.ft. per second.}$$

Simple Accounting System for an Engineering Office

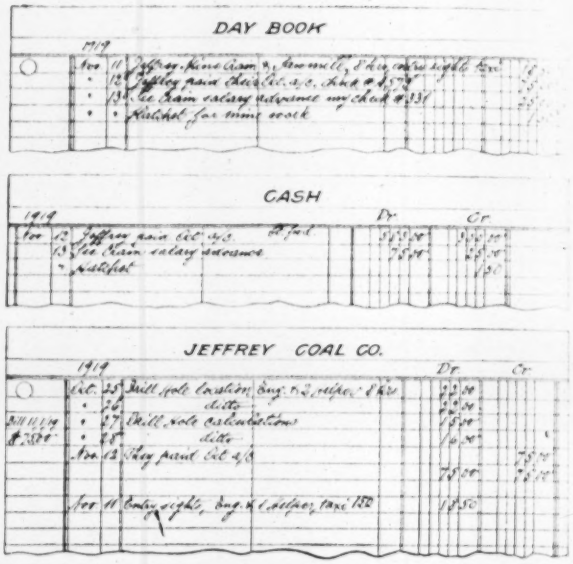
By G. N. Pfeiffer
Consulting Engineer, Herrin, Ill.

WHEN I opened an engineering office one of my problems was to provide a proper system of account keeping. I am not a bookkeeper. At the start I could not afford to employ an experienced man to take care of the books although it was very probable I would do so later on. After a day's work in the field I did not care to spend much time on the books in the evening.

After due consideration I decided that any system, to be adopted, must meet the following conditions: (1) It must be simple. (2) The books must be kept by myself for a time. (3) It must be possible to determine, at any time and in a very short time, the amount due me from any client. (4) The system must permit of expansion with the business. (5) Daily work records must be made by chiefs of parties, and incorporated in the permanent office record. (6) The date and amount of the last statement to any client must be evident at a glance.

Since an engineer with a party is often away from the office for a week or more I decided on a letter-size loose-leaf system, using for simplicity the same form and size of sheet for day book, cash book and ledger. At a local store I bought a holder and some loose leaves already punched and ruled. Part of a page from each of the three books is shown in the illustration.

The posting took but a few minutes two or three times a week. It was only when sending out statements [illegible] the end of the month that more time was needed. N[illegible] of the engineers or helpers had access to the bo[illegible] except in the case of the one sheet containing the d[illegible] work records. At the end of the month, or when [illegible] this one sheet was filed with any other records.



TOPS OF DAY BOOK, CASH BOOK AND LEDGER PAGES SHOWING ENTRIES AND NOTATIONS

An entry in the day book, when posted on the credit side of the cash book or ledger, had a check mark placed after it; when posted on the debit side it was followed by a cross-check mark; and it was followed by the latter superimposing the former when posted to credit in one book and debit in the other. From these marks I could tell whether I had posted all the items I cared to post. Another notation for convenience was to write in the left margin the date and amount of statement rendered. The notations are shown in the sample sheets illustrated.

The foregoing system worked out successfully for me, and later, when the business expanded and a firm was formed, it was easily modified to suit.

Results of Cleaning Water Mains

The distribution mains in the southern section of the city were laid during the eighties, and therefore after thirty-five years of service their carrying capacity, due to tubercles, have been reduced to less than 40 per cent of that of new pipe. Upon authority, the Department cleaned a total of six miles of 6-in. mains throughout the older portions of the city during the summer and fall. A test to determine the loss of head or friction before and after cleaning showed that on an average the carrying capacity of the mains for the same loss of head had been increased to 2.6 times the capacity before cleaning. The total cost of the work, including labor, materials and royalties, was $3,267.84 or 10.32 cents per foot.—J. E. Gibson, Manager and Engineer Water-Works, Charleston, S. C., in annual report for 1919

the "Average Engineer"

Table for Use in Converting Stations to Miles

By R. T. Brown
Chief of Surveys, State Highway Department of South Carolina

THE table given herewith will be of service to engineers who frequently have occasion to convert stations to miles and vice versa. This applies especially to highway engineers. When such a table is not on hand, and one does not wish to go to the refinement of actually dividing out the stations to convert to miles, the following method will be found convenient and correct to within one tenth mile up to twenty miles:

Place decimal point between tens and hundreds in the number of stations. Multiply by two. From result subtract number of stations with decimal point to left of hundreds.

Example—Convert 317 + 00 to miles. 3.17 × 2 = 6.34, 6.34 — 0.317 = 6.02 miles. Actual distance is 6.004 miles. With the table given below as a basis this computation can very easily be performed mentally when looking at a map or driving along the road.

CONVERSION TABLE—STATIONS TO MILES
TENTHS OF MILES

Mi.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0+00	5+28	10+56	15+84	21+12	26+40	31+68	36+96	42+24	47+52
1	52+80	58+08	63+36	68+64	73+92	79+20	84+48	89+76	95+04	100+32
2	105+60	110+88	116+16	121+44	126+72	138+00	137+28	142+56	147+84	153+12
3	158+40	163+68	168+96	174+24	179+52	184+80	190+08	195+36	200+64	205+92
4	211+20	216+48	221+76	227+04	232+32	237+60	242+88	248+16	253+44	258+72
5	264+00	269+28	274+56	279+84	285+12	290+40	295+68	300+96	306+24	311+52
6	316+80	322+08	327+36	332+64	337+92	343+20	348+48	353+76	359+04	364+32
7	369+60	374+88	380+16	385+44	390+72	396+00	401+28	406+56	411+84	417+12
8	422+40	427+68	432+96	438+24	443+52	448+80	454+08	459+36	464+64	469+92
9	475+20	480+48	485+76	491+04	496+32	501+60	506+88	512+16	517+44	522+72
10	528+00	533+28	538+56	543+84	549+12	554+40	559+68	564+96	570+24	575+52
11	580+80	586+08	591+36	596+64	601+92	607+20	612+48	617+76	623+04	628+32
12	633+60	638+88	644+16	649+44	654+72	660+00	665+28	670+56	675+84	681+12
13	686+40	691+68	696+96	702+24	707+52	712+80	718+08	723+36	728+64	733+92
14	739+20	744+48	749+76	755+04	760+32	765+60	770+88	776+16	781+44	786+72
15	792+00	797+28	802+56	807+84	813+12	818+40	823+68	828+96	834+24	839+52
16	844+80	850+08	855+36	860+64	865+92	871+20	876+48	881+76	887+04	892+32
17	897+60	902+88	908+16	913+44	918+72	924+00	929+28	934+56	939+84	945+12
18	950+40	955+68	960+96	966+24	971+52	976+80	982+08	987+36	992+64	997+92
19	1003+20	1008+48	1013+76	1019+04	1024+32	1029+60	1034+88	1040+16	1045+44	1050+72
20	1056+00	1061+28	1066+56	1071+84	1077+12	1082+40	1087+68	1092+96	1098+24	1103+52
21	1108+80	1114+08	1119+36	1124+64	1129+92	1135+20	1140+48	1145+76	1151+04	1156+32
22	1161+60	1166+88	1172+16	1177+44	1182+72	1188+00	1193+28	1198+56	1203+84	1209+12
23	1214+40	1219+68	1224+96	1230+24	1235+52	1240+80	1246+08	1251+36	1256+64	1261+92
24	1267+20	1272+48	1277+76	1283+04	1288+32	1293+60	1298+88	1304+16	1309+44	1314+72
25	1320+00	1325+28	1330+56	1335+84	1341+12	1346+40	1351+68	1356+96	1362+24	1367+52
26	1372+80	1378+08	1383+36	1388+64	1393+92	1399+20	1404+48	1409+76	1415+04	1420+32
27	1425+60	1430+88	1436+16	1441+44	1446+72	1452+00	1457+28	1462+56	1467+84	1473+12
28	1478+40	1483+68	1488+96	1494+24	1499+52	1504+80	1510+08	1515+36	1520+64	1525+92
29	1531+20	1536+48	1541+76	1547+04	1552+32	1557+60	1562+98	1568+16	1573+44	1578+72
30	1584+00	1589+28	1594+56	1599+84	1605+12	1610+40	1615+68	1620+96	1626+24	1631+52
31	1636+80	1642+08	1647+36	1652+64	1657+92	1663+20	1668+48	1673+76	1679+04	1684+32
32	1689+60	1694+88	1700+16	1705+44	1710+72	1716+00	1721+28	1726+56	1731+84	1737+12
33	1742+40	1747+68	1752+96	1758+24	1763+52	1768+80	1774+08	1779+36	1784+64	1789+92
34	1795+20	1800+48	1805+76	1811+04	1816+32	1821+60	1826+88	1832+16	1837+44	1842+72
35	1848+00	1853+28	1858+56	1863+84	1869+12	1874+40	1879+68	1884+96	1890+24	1895+52
36	1900+80	1906+08	1911+36	1916+64	1921+92	1927+20	1932+48	1937+76	1943+04	1948+32
37	1953+60	1958+88	1964+16	1969+44	1974+72	1980+00	1985+28	1990+56	1995+84	2001+12
38	2006+40	2011+68	2016+96	2022+24	2027+52	2032+80	2038+08	2043+36	2048+64	2053+92
39	2059+20	2064+48	2069+76	2073+04	2080+32	2085+60	2090+88	2096+16	2101+44	2106+72
40	2112+00	2117+28	2122+56	2127+84	2133+12	2138+40	2143+68	2148+96	2154+24	2159+52
Hundredths of mile.		0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
Equals in feet		52.8	105.6	158.4	211.2	264.0	316.8	369.6	422.4	475.2

A Simple System of Indexing Notes and Plans

Filing by Location Preferred to Other Methods—Key Map Has Numbered Areas—Loose Leaf Ledger Used

By F. Deane Avery
Engineer and Architect, Greenfield, Mass.

FROM time to time there have appeared various articles describing indexes for notes and plans but most of them seem to me to be more complex than necessary for an ordinary engineering and surveying office. In planning such an index we should keep in mind the essentials which I believe are three in number: Speed in indexing; speed in finding; and positive action.

First, to make an index which can be maintained in the least time: The systems most in favor seem to be some form of card index with cross indexes, but a cross index takes time. About the simplest have two cards—one for the owner's name and one for the subject—while a system which gives also the adjoining owners and the location will require eight cards for the survey of an ordinary city lot. It takes twice as long to write two cards as it does for one, so that a one-card system saves on the cost of indexing, which is the first object on our list.

Second, to make an index which will save time in

searching for things: Before deciding this let us consider under what conditions we start our search, as for example, for field notes of John Jones' lot on North St. We may know that a survey was made for him a few years ago and in that case the ordinary name index will find the data promptly. If, as is usually the case, we do not know whether there are any notes of a previous survey, we are all at sea.

The average man will look up Jones and finding nothing will address a question to the office in general as to whether anyone knows of such a survey. That usually ties up the whole office and finally after looking up several names which might be near there it is decided that probably there are no old notes.

Third, to make an index that will be positive in action so that we can *either find what we want or prove that there is no such thing!* As shown above the greatest trouble is to prove that there are notes or maps of the territory or structure in question. Any index of names is of use only to the man who remembers what name to look for. Any index by subjects is usually too large to be efficient. Any index by location requires areas small enough so that it can be quickly gone over.

Index by Location Preferred

Filing by location, in my opinion, is the whole secret of successful indexing of surveying notes. It is difficult to imagine wanting notes or a map of any spot without knowing where the spot is located. My own index is based on that principal and I will outline it briefly for the benefit of any who care to use it.

I have divided my territory small enough so that a page will be sufficient for indexing everything within that area. These areas are indicated on maps (two in my case) and a number assigned to each area. In this city it means that practically each block has a number, but in the outside districts one number is still sufficient for an entire town. I have one book for plans and one for notes and all notes or plans for any block are indexed on the page corresponding to the number of the block. That is if block 60 is bounded by north, east, south and west streets, all notes and maps for that block will be indexed on page 60 of the proper index book.

A map would appear on the index as "John Jones, Lot Survey, Lot 83, North Street near East—Date, Scale, Kind, File number." The brief description fixes it so that one seldom has to go beyond the index to find out whether it is the plan wanted.

In addition to the numbers showing locations on the map I have assigned one number for general maps of the city, one for maps outside the territory covered by the key map, and one for buildings. The last is because I do certain kinds of architectural work and in addition to the location index I keep a list of buildings separated according to kinds. Street plans, which are few in number, take the numbers to south or east, except that long plans may be under the general map of the city.

Subdivision plans are indexed under every block covered.

Tables are not indexed as maps but are listed in a card index with other miscellaneous data. A page could be added for these if desired.

This system takes less time to maintain or use than any other index I ever saw. Most items require one entry only, and as there is no question where to index there is also no question where to look for it later.

A Dozen Articles f

I use a loose leaf ledger although the system would the same if one preferred cards. After experience charge of four different offices—two of which had indexes—I will say that in my opinion the loose is far superior for this purpose. The chances for er are less than with a card index. Cards may be placed or lost or overlooked, but pages that are nu bered and in order can always be found, and it is mu simpler to glance over twenty items on one page th to look over twenty cards one by one. The only adva tage of loose leaf over a bound book is that pages can rewritten if soiled, or if one wants to further divid the territory.

Abstracts of deeds, and descriptions written for deed with accompanying correspondence are put in bundles numbered according to the key, and kept in numerical order, in drawers. These could be indexed but I have not thought it worth while in my case.

I believe that the majority of plans are best filed flat but whether flat or rolled use standard sizes and do not put two sizes in a drawer or pigeon hole. If one cares to do so it is easy to subdivide by subject on each page but I prefer to keep the areas so small that it is not necessary. I use two colors of ink—green for notes and maps made before I came into the office, and black for those since. Maps which are referred to frequently are often indicated by a red mark on the margin.

It costs something to make a good index but after that it is a time saver and a constant source of satisfaction. In my opinion a location index is the only one of any value to any one except the one who makes it, and for that reason most of the old survey notes are lost to future generations.

Permit me to repeat the essentials. Divide your territory into areas, assign a number to each area, and have a corresponding page in the index book. Put plans of a size together and describe locations as fully as possible in the index. As time permits get the old notes into the new index, and then get your competitors to use the same system—perhaps the same key map. If surveyors could easily find old records and would consult with each other there would be fewer discrepancies and their reputations would be enhanced.

Weight of Rail in Tons

By George W. White
Assistant Engineer Southern Railway

WEIGHT of rail in gross tons (2240 lbs.) for various sizes from 45 lb. to 100 lb. per yard and from one to nine feet in length, figured to nine decimal places for one foot and to eight places for other lengths may be readily calculated by use of the accompanying table. By shifting the decimal point, the weight to three decimals for any length up to two million feet will be given.

To use the table, select from the column of tons, under the proper weight of rail, the figures opposite the number of feet desired, using each digit of the number separately, and moving the decimal point to correspond with the position of that digit Then add these figures together. Use only the number of decimal places desired in the result, and notice the fraction added or discarded

the "Average Engineer"

each case so as to adjust the total to the nearest figure.

These tables are especially serviceable if an adding

WEIGHT OF RAIL IN TONS PER FOOT OF LENGTH — 45 LB. TO 100 LB. SECTIONS

Ft.	Tons 45 Lb. Rail	Ft.	Tons 50 Lb. Rail	Ft.	Tons 56 Lb. Rail	Ft.	Tons 60 Lb. Rail
1	006 696 429	1	007 440 476	1	008 333 333	1	008 929 571
2	013 392 86	2	014 880 95	2	016 666 67	2	017 857 14
3	020 089 29	3	022 321 43	3	025 000 00	3	026 785 71
4	026 785 71	4	029 761 90	4	033 333 33	4	035 714 29
5	033 482 14	5	037 202 38	5	041 666 67	5	044 642 86
6	040 178 57	6	044 642 86	6	050 000 00	6	053 751 43
7	046 875 00	7	052 083 33	7	058 333 33	7	062 500 00
8	053 571 43	8	059 523 81	8	066 666 67	8	071 428 57
9	060 267 86	9	066 964 29	9	075 000 00	9	080 357 14

Ft.	65 Lb. Rail	Ft.	70 Lb. Rail	Ft.	75 Lb. Rail	Ft.	80 Lb. Rail
1	009 672 619	1	010 416 667	1	011 160 714	1	011 904 762
2	019 345 24	2	020 833 33	2	022 321 43	2	023 809 52
3	029 017 86	3	031 250 00	3	033 482 14	3	033 714 29
4	038 690 48	4	041 666 67	4	044 642 86	4	047 619 05
5	048 363 10	5	052 083 33	5	055 803 57	5	059 523 81
6	058 035 71	6	062 500 00	6	066 964 29	6	071 428 57
7	067 708 33	7	072 916 67	7	078 125 00	7	083 333 33
8	077 380 95	8	083 333 33	8	089 285 71	8	095 238 10
9	087 053 57	9	093 750 00	9	100 446 43	9	107 142 86

Ft.	85 Lb. Rail	Ft.	90 Lb. Rail	Ft.	95 Lb. Rail	Ft.	100 Lb. Rail
1	012 648 810	1	013 392 857	1	014 136 905	1	014 880 952
2	025 297 62	2	026 785 71	2	028 273 81	2	029 761 90
3	037 946 43	3	040 178 57	3	042 410 71	3	044 642 86
4	050 595 24	4	053 571 43	4	056 547 62	4	059 523 81
5	063 244 05	5	066 964 29	5	070 684 52	5	074 404 76
6	075 892 86	6	080 357 14	6	084 821 43	6	089 285 71
7	088 541 67	7	093 750 00	7	098 958 33	7	104 166 67
8	101 190 48	8	107 142 86	8	113 095 24	8	119 047 62
9	113 839 29	9	120 535 71	9	127 232 14	9	133 928 57

machine is available for use in connection with them. They will be found to be great time savers, where there is much figuring of this sort to be done.

Finding Rivet Pitch in Plate Girders Quickly

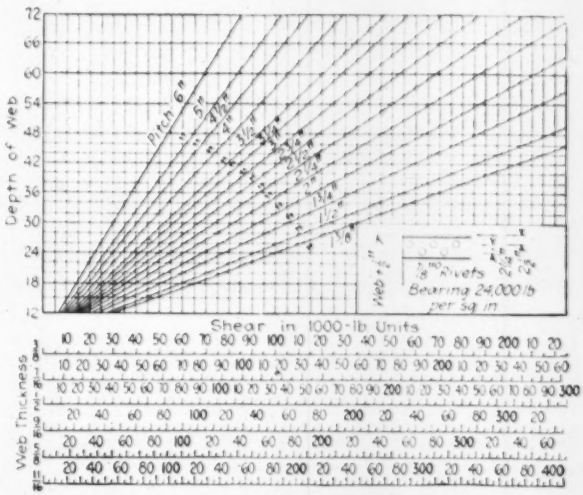
By Ralph Smillie
New York City

IN THE accompanying diagram for the rapid determination of rivet pitch in plate girders, two lines of ⅞-in. rivets are used as basis of calculation, so that the diagram applies to 6 x 6-in. flange angles. It is based on a bearing value of 24,000 lb. per square inch

The diagram solves the equation $p = \frac{dV}{S}$ in which p is the rivet pitch in inches, d the depth between centers of gravity of flange rivet lines in inches, V the value of one rivet, and S the shear, the latter two being in the same unit (pounds or thousands of pounds). The value of V obviously varies with the web thickness, but it is convenient to remember that the double shear value of a ⅞-in. rivet is substantially the same as its value in bearing on an ½-in. web.

To illustrate the use of the diagram, suppose a girder with 48 x ⅜-in. web carries a shear of 100,000 lb. In the lower scales, for web thickness, select the line marked ⅜, and go vertically from the value 100 (representing 100,000 lb.) on this line to the horizontal line representing 48-in. depth of web. The intersection lies between the sloping lines 3 and 3½, and the required pitch therefore is 3 in.

When only one rivet line is used the depth for entering the diagram may be taken 2 in. greater than the actual depth and the result will be very close to correct. If the above girder, for example, had 6 x 4 flange angles. 50 in. may be used for the depth, and the pitch will be found to be 3¼ in.



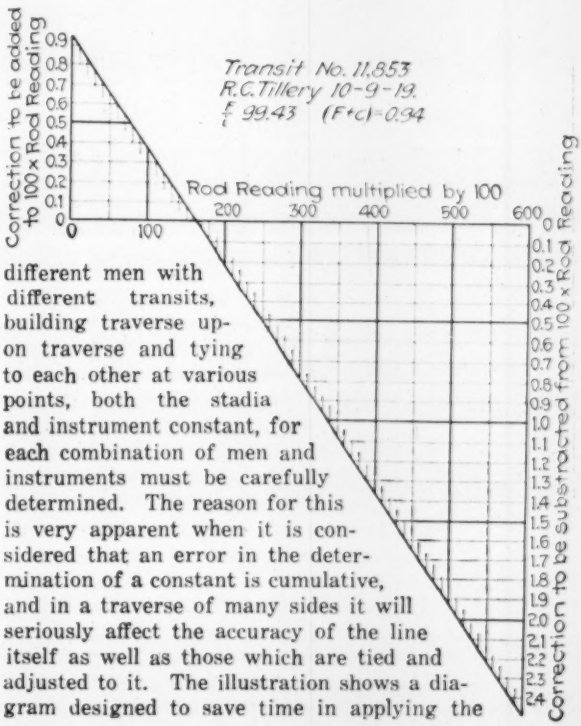
Rivet Pitch Diagram for Plate Girder Flanges, with Two Lines of ⅞-in. Rivets.
For bearing value 24,000 lb. per square inch

Obviously, the diagram is not applicable to railway deck girders or others that carry concentrated loads directly on the flanges.

Practical Method of Applying Stadia Constants

By W. J. Nuebling
Badin, N. C.

FOR many purposes the stadia constants as determined by the instrument maker are practical, but as these constants vary with the seasons of the year, the age of the instrument, the man, and other factors, very close attention must be given to individual constants when accurate results are required. In a system of surveys wherein lines are run by a number of


Transit No. 11,853
R.C.Tillery 10-9-19.
f/i 99.43 (F+C)-0.94
Correction to be added to 100 x Rod Reading
Rod Reading multiplied by 100
Correction to be subtracted from 100 x Rod Reading

different men with different transits, building traverse upon traverse and tying to each other at various points, both the stadia and instrument constant, for each combination of men and instruments must be carefully determined. The reason for this is very apparent when it is considered that an error in the determination of a constant is cumulative, and in a traverse of many sides it will seriously affect the accuracy of the line itself as well as those which are tied and adjusted to it. The illustration shows a diagram designed to save time in applying the

stadia and instrument constant to the different rod readings. As these diagrams are easily and quickly made it is handy to have one for each instrument and instrument man. To construct this diagram the constant $(F + C)$ is first laid off to a convenient scale to a point above the line. Next the correction is figured for the maximum sight length, the point is platted either above or below the base line, depending upon whether it is positive or negative, and the points are connected by a straight line. Corrections for the rod readings are indicated on the connecting line where it is intersected by perpendicular lines from the base.

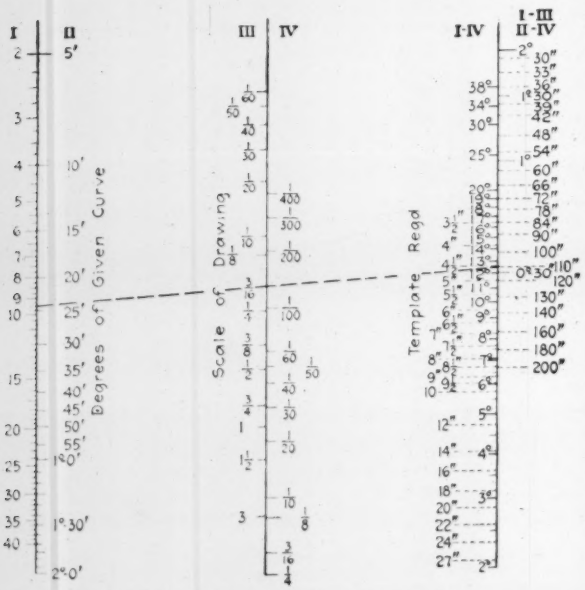
After the correction has been applied to the rod reading the correction for the vertical angle is made by multiplying the corrected rod reading by $cos^2 A$. This method, although not theoretically exact, will check the theoretic formula within a few hundredths of a foot for small angles and one or two-tenths for large angles and distances. Good results can also be obtained in figuring the vertical differences by multiplying the corrected rod reading by $\frac{1}{2}$ *sin.* 2 *A*.

Chart Showing Template for a Given Degree of Curve to Any Scale

By Donald P. Maxwell
Aluminum Company of America

In THE *Engineering News-Record*, March 4, 1920, p. 486, there was given a conversion table for plotting curves. This problem is solved particularly well by means of a chart of the alignment type. One devised by the writer and adapted to the curves used in this office, namely, one set marked in degrees to 100 scale, the other marked in inches radius, is submitted herewith.

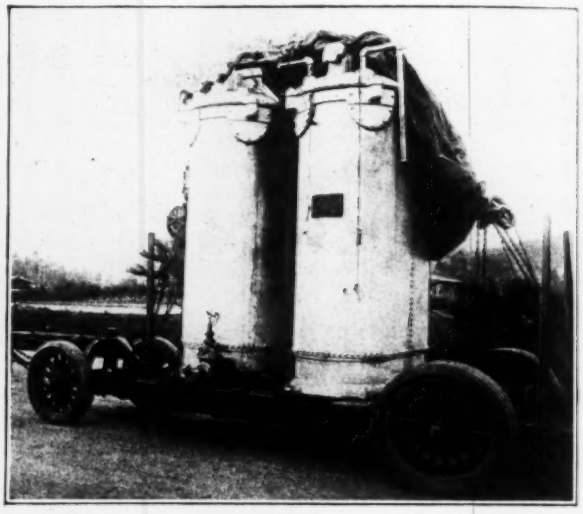
By doubling the scales the chart is made very compact and no difficulty will be found in reading the chart if attention be paid to the Roman numerals designating the several scales. Thus, if the given curve be found on scale II and the scale of the drawing on scale IV read the required template on scale marked II-IV.


I
II
III
IV
I-IV
I-III
II-IV
Degrees of Given Curve
Scale of Drawing
Template Regd
Example: What template must be used for a 9°30' curve on 1/8" = 1'-0" Connect 9°-30'(I) to 1/16"(III) and read 110 lb on (I-III) (0°30' may be used)

An Auto-Trailer That Carries a 28-Ton Load

In ORDER to move heavy transformers for supplying emergency demands the Southern California Edison Company of Los Angeles designed and built an automobile trailer suitable for carrying 24 tons. This was done when it was found that shipping transformers by rail often required a week or more and left unsolved the problem of getting the heavy equipment from the railroad siding to the exact location desired. Having the equipment out of service even for such a period was a serious loss during times of limited power supply.

The company, therefore, built a trailer, shown in the accompanying illustration, which has successfully handled 28-ton loads. Since it has been used there has seldom been a delay of more than 24 hr. in moving heavy equipment over distances up to 100 mi. whereever destination could be reached over good roads, such being the case in most of the communities served by the company.



HEAVY DUTY TRAILER DESIGNED BY CALIFORNIA CONCERN

Two features of the trailer design are that it is without springs, and the forward axle is arched so that the bed is suspended by king-pin and links. The bed is 18 ft. long and the overall width is 8 ft. 3 in. The diameter of the front wheels is 36 in. and of the rear wheels 42 in. Wheels are equipped with solid rubber tires, the rear tires being 14 in. wide. The lift to the top of the bed is 25 in. and the clearance is 15 in. When handling capacity loads the trailer is usually drawn by a 6-ton. truck with 5 tons of ballast.

The first truck built by the company at a cost of about $2,300 was in constant demand and was found to be so useful that a second one was constructed, the only change in design in the second trailer being the addition of band brakes operated by an 8-ft. level to which a rope from the driver's feet was attached. The design has been copied by three trucking companies.

P. H. Ducker is superintendent of transportation for the Southern California Edison Co.

Qualifications of the Teacher of English for Engineers

VIEWS of older engineers on the subject of teaching English to the undergraduate are unanimously in favor of giving more and better courses. The type of teacher required is a vital point since the student generally is not attracted to English. These are the conclusions reached in a paper presented recently to the Society for the Promotion of Engineering Education by Miss S. A. Harbarger, department of English, Ohio State University. The paper was based on a questionnaire to deans of engineering schools, interested instructors in English, heads of departments and special teachers. Miss Harbarger has had 12 years' experience teaching engineers. Extracts from her paper follow:

The experience of the most successful teachers in English to engineering students seems to have demonstrated convincingly that the college course should start with the students' interest in engineering and should make plain to them that they need English (1) to amplify, reinforce, make clear and extend the range of ideas expressed through drawings and mathematical symbols, (2) to become articulate for the purpose of rendering, through their profession, effective and constructive service to the world, and (3) to be able to take their rightful place among men of other professions as progressive leaders in their communities.

The pronounced characteristics of the engineering student are definiteness, practicality, eagerness and youthfulness. These have a direct bearing upon the English teacher. His own characteristics must be complementary and supplementary if he is to recognize and capitalize these traits and to give his students, through training in the effective communication of ideas, orientation, reach, restraint, balance and power.

First of all, the teacher of English must realize that the engineer needs English as a powerful tool, capable of a variety of uses that will bring financial returns and advance professional prestige. Though he may, before the course is completed, lead out into some of the cultural aspects of English, by subtle references and appropriate comparisons, yet he never loses sight of the fact that engineers need English as a tool. He associates English, therefore, with reality and finds an objective for his students' thoughts, as they express them in speech and in writing, that is within their range and that leads toward their goal. He attempts to guide constructively their imaginations, through system, clearness and accuracy to a fine, honest sense of proportion and relative values and independent thinking. He trains for remorseless and scientific efficiency in the use of words for the purpose of getting tangible results.

Only a few think that the teacher of English should have an engineering degree. But unquestionably he must have an interest in science and some engineering aptitude, whereby he will intuitively understand and sympathize with the problems and ambitions of his students. He must be sincerely interested in the whole aim and trend of engineering education; respect and be stimulated by engineering projects, vast and small; be a good listener and get men to talk enthusiastically of their work. He must have enough knowledge of the hardships and the difficulties that are encountered in an engineering undertaking to appreciate, not only the cost in dollars and cents but in energy and spirit, and to understand the justifiable glow of elation and victory that every engineer has when his work is complete, safe and useful.

The instructor in English must be able to write articles that are acceptable to technical journals and magazines. Definite results of theory wherever they appear always impress engineering students. If in their perusal of technical periodicals—for every good teacher of English will turn the attention of his students early to the current literature of his profession—they come upon articles written by the instructor, the prestige of English and of the instructor rises.

A wide acquaintance with practicing engineers through their writings and through personal friendship is a peculiar asset of the teacher of English. This acquaintanceship is vital if the instructor is to keep his teaching rich, full, forward-looking and telling. He learns from both sources the tendencies of modern engineering thought.

Another qualification in the instructor of English is a phase of personality that gains from the faculty of the engineering college the confidence, the active cooperation, the constructive criticism and the further stressing as a part of every course, of the need and the value of good English for the engineer.

Finally, the vocational guidance instinct should be present in every good instructor of technical students, but the English teacher is likely to have the most accurate and extended information. He deals generally with the first-year men; he has the best source of any instructor of freshmen from which to obtain an intimate knowledge of their aims and aspirations, their previous experience, their immediate difficulties and shortcomings. The instructor in English, through the personal conference with each student, which is a necessary part of the teaching, and through the weekly themes which are written on assigned topics, acquires a very detailed and definite knowledge of his students. To the experienced teacher the themes have much significance, for they indicate the student's state of rest or unrest. The personal conference checks the impression gathered from the themes; consequently the instructor can make some very reliable assumptions. The fatalities among first-year men are great; the unrest and often open dissatisfaction among fourth-year men are too wide spread. Until the data of intelligence tests can be given extended study, application and until colleges can give more time to the study of each individual, there is need for someone somewhere along the line to apply the rudiments of vocational guidance in order to save everyone time and effort.

If engineering faculties and engineering societies would state definitely what they need, take active steps toward recognizing English as a subject fundamental to successful engineering practice, and ask for the teacher with the special qualification, they could raise the standard of English teaching in all engineering colleges.

Moisture Content of Wood Is Not Dependent on Density

Even after long exposure to the same atmospheric conditions, different pieces of wood do not have exactly the same moisture content. Variations of 2 per cent were recently found in red oak blocks stored under carefully fixed humidity conditions at the Forest Products Laboratory. These moisture differences, unlike variations in strength, are apparently independent of the density of the pieces. In the laboratory experiments, the variation proved to be as great in blocks of the same density as it was throughout the lot of specimens. Moreover, the range in moisture content was the same in wood of low density as in wood of medium density or high density.

Data on a few representative specimens are given in the accompanying table:

Density of specimen	Average moisture content in percentage of weight oven-dry. Relative humidity at 80 deg. F.		
	38%	61%	88%
Low			
0.519	7.6	11.2	19.4
0.527	6.0	10.0	17.4
0.536	6.5	11.0	18.2
Medium			
0.630	7.7	11.5	18.9
0.639	5.8	10.7	18.3
0.643	6.8	11.5	19.5
High			
0.720	6.4	11.2	19.3
0.724	7.4	11.4	19.6
0.753	6.1	10.8	18.9
Total average	6.7	11.0	18.8

New Steamship Piers on Staten Island Are Too Narrow

Consensus of Engineering Opinion Is That New York's New Development Is Being Made With Too Great Regard for Present Conditions and Not Enough for Engineering Principles

In "Engineering News-Record," May 27, 1920, p. 107, under the title "New York to Build Steamship Piers on Staten Island," there was published a description of the new Stapleton development now under construction by the city.

The fundamental principle in the design of these piers is that the steamship interests who lease them should dictate the type to be adopted. On this basis eight of the piers are 125 ft. wide with one-story sheds completely covering them; two are 130 ft. wide with complete two-story sheds; and two are 209 ft. wide with two-story sheds 131 ft. wide and with railway tracks and freight-handling equipment on the piers outside the sheds. The latter will also have central railroad tracks but the other piers are not to have tracks though structural provision for such tracks is made in the substructure.

Much discussion has been aroused in engineering circles regarding the inadequacy of these piers, particularly in respect to width and machinery equipment. As stated in the earlier article, the Department of Docks has denied that the body of competent engineering opinion is in opposition to the design. "Engineering News-Record" has thought it worth while to ask the opinion of some of the leading port and terminal engineers as to this particular phase of the Stapleton development. These opinions are printed below; comment upon them appears in the editorial pages.—EDITOR.

Narrow Piers Generally Obsolete

BY JOHN MEIGS
Consulting Engineer, Philadelphia, Pa.

The recently announced plan of the Department of Docks of the City of New York for the construction of a series of twelve piers in the Stapleton section of Staten Island is perhaps the most extensive and costly project of port development yet undertaken at one time by any American community, if we bar the several marine terminal constructions of the United States Government during the recent war. As such, and because of the national character of the port of New York, the importance of this projected improvement far exceeds mere local dimensions and becomes so widespread in scope that the entire country can legitimately participate in the consideration of its details. It is evident, therefore, that no excuse is needed for comments concerning it on the part of non-residents of the New York district.

That the Dock Department authorities are proceeding in the right general direction in locating this pier group on Staten Island—the only portion of New York City on the continental side of the harbor of New York—is beyond dispute; as additional development of the westerly side of the harbor has been advocated for many years by practically all engineers who have given any study whatever to the problem of the proper future development of the port of New York. The location on the easterly, or European, side of the harbor of the principal trans-shipment piers for freight destined for transfer between the American continent and overseas, or vice versa, has been recognized for many years as being in defiance of the most elementary laws of economics in freight handling.

No legitimate excuse can be offered for the continuance of the absurd practice, in vogue so many years in this port, of transferring overseas freight of continental origin from the railroad termini on the New Jersey shore, by a crude and expensive lighterage system, to the opposite side of the harbor for reloading at that point into ships, when the transfer between the rail carriers and the water carriers could be made with equal facility and a fractional part of the cost at piers on the New Jersey side. For these reasons the department can be heartily commended for its announcement of a policy involving the development of the westerly side of the harbor rather than in the exclusive spending of city funds in further improvement of the easterly side of the harbor for general cargo transference purposes.

Of course, the piers of New York and Brooklyn will continue to be of use for the handling of cargoes intended mainly for distribution within the limits of the boroughs of Manhattan and Queens, and for southern New England generally, and for cargoes made up from these sections for trans-shipment abroad, but for the vast bulk of freight destined for distribution to points south of the Hudson and westwardly through the range of states bordering the Great Lakes, and for freight originating in these sections for trans-shipment abroad, these movements will in future be handled very largely on the New Jersey side of the harbor, or in other ports geographically and hydrographically better situated for this purpose than are Manhattan Island and Long Island, notably the ports of Philadelphia, Baltimore and Norfolk.

PIERS EXTREMELY NARROW

Considering the extraordinary importance of the precedent which is now being set by the New York Dock Department, the problems involved in the design of these piers should have had the most careful and even prayerful consideration by the best authorities obtainable on these subjects. Presumably they have been given this consideration, but the result of the careful studies of the Dock Department's authorities is, on the face of the returns, somewhat disconcerting to the average port engineer who is familiar with the modern trend in the design of piers—which is, first, toward a radical increase in their width; second, toward the providing of them with direct railroad connections wherever possible; and, third, toward the equipment of them with modern freight handling machinery for facilitating the loading and discharge of cargo.

The most striking feature of the layout of the Stapleton piers is their extreme narrowness compared with modern piers in other ports. All of the Stapleton piers except two, it is noted, are but 125 or 130 ft. wide,

this element of the design appears to have been decided mainly by the current practice for generations past in New York City, rather than by any reference to the actual needs of present-day marine cargo handling and storage facilities.

It is generally considered, among port designers, that the transfer sheds for the handling of cargo to and from ships should be planned of sufficient width to accommodate approximately the total bulk of cargo carried by the average vessel, in a length of shed approximately the same as that of the vessel itself. This restriction as to the length of storage area allotted per cargo is in order that the transfer of cargo from its place of deposit on the pier to the vessel, and vice versa, should be through the shortest possible horizontal distance; and as to width, on the theory that properly to take care of both the inbound and outbound cargo, storage space for the equivalent of one complete cargo should be provided on the pier itself opposite each ship berthing thereat.

It is held that the proper place for the assembly of a ship's cargo is on the pier, at the ship's side, and not in railroad cars in holding yards, as is the current practice in the New York district; the piers 125 ft. wide are simply not capable of performing this function. Recent piers in Montreal, Boston, Philadelphia, Baltimore, Norfolk, Seattle and other modern ports range from 200 to 400 ft. in width, and are found to be admirably suited to their purposes and are none too large for economy of operation.

It is argued by the narrow-pier cult that it is foolish for pier owners to provide extra width on piers for the purpose of assembling cargo when the railroad companies are entirely willing to furnish from 20 to 30 days free storage of export freight in cars which are held by them in their terminal yards for delivery to the steamship companies on demand. The economic fallacy of this is perfectly apparent when we consider the relative cost of accommodations for the storage of freight in railroad cars and in pier sheds or warehouses adjacent to the piers. On the basis of present-day freight-car prices, the cost of storage space in cars, including the value of the tracks upon which they stand in the holding yards, is from $8 to $10 per square foot; and, notwithstanding the present tremendously inflated costs of piers and warehouses, similar accommodations can be provided in such structures for not more than one-third to one-half of what car-storage space would cost.

Shortage of Railroad Equipment

The present paralysis of railroad business throughout the country is not ascribable to any one particular cause, being due to many co-ordinate ones, but among these contributory causes none is more important than the unnecessary placing out of commission of cars held in terminal yards, diverted from their proper purpose as mediums of transportation and converted into improper use as portable warehouses for the time-storage of freight. With the crying shortage of railroad equipment that the railroads have labored under for years past, and the tremendous financial difficulties under which they will be compelled to struggle for years to come, it is of primary importance that every means possible be utilized to introduce proper economies in railroad operation. One of the most obvious means of accomplishing this end is by providing facilities at the marine terminals for the immediate discharge of freight cars upon arrival thereat and their prompt reloading and return to the railroads for legitimate use as transportation equipment, instead of holding them indefinitely as mere warehouses, in accordance with present practice.

Naturally, as long as steamship owners and operators are permitted to take advantage of the laxity of the railroads, and the good nature of the American public which is paying the bills, this practice may be expected to continue, but eventually, either now or later—when sane business principles are permitted to govern such matters—this source of lost motion and wasteful expenditure will inevitably be eliminated.

When this time comes, it will be found that the operators of piers of insufficient width to properly take care of the distribution and assembling of ships' cargo thereon will be most seriously handicapped in competition with better equipped terminals, and will then be forced to provide additional pier accommodations or to continue to do business at tremendously greater cost to themselves than their competitors are subjected to.

Another noteworthy feature of the Stapleton pier layout is the failure on most of the piers to take advantage of the opportunity afforded by the proximity of the Baltimore & Ohio R.R. tracks in their rear to make direct rail connection between them and this important trunk-line railroad. When we consider that perhaps 75 per cent of the import freight arriving in New York harbor is destined for transfer into the interior of the country by rail, and that an equal proportion of the export freight arrives by rail, this lack of pier tracks would seem to be an extraordinary omission on the part of the designers.

This apparent mental lapse is, of course, explained by the prevailing and uneconomic system of railroad rates in the New York district. Under this system—which, although it has been in vogue for generations past, cannot continue in defiance of proper economic laws indefinitely—car transfer service by floating equipment is furnished by the railroads free of cost between their terminal yards and all points in the harbor within predetermined lighterage limits. Under this paternal custom it is, of course, more economical for the pier owners to load freight into railroad cars placed, at no expense to themselves, alongside of their piers or ships on car floats kindly furnished by the railroads, than it would be to load the same cars situated on running tracks located on their own piers—which tracks, and the deck area occupied by them, would have to be provided at their own expense.

The argument of the New York Dock Department that piers without tracks are satisfactory to their tenants and are therefore justifiable, is valid only so long as the system of free lighterage of railroad cars continues. The moment this inherently vicious practice is abolished—as it is bound to be in time, in the distant if not in the near future—from that time forward the absolute necessity for railroad connections on piers will be manifest. Piers not so provided, and therefore subjected to the additional cost of car transfer by water between the ship and some distant railroad yard, will be so severely handicapped in the competitive handling of freight that the owners will be found to suffer financial losses therefrom.

As to the mechanical equipment of these piers, or lack

of it, as mentioned in their published description, it would be quite impossible to form any proper conception of the necessities of the case without knowing at least to some extent for what purpose it is anticipated the piers will be used. Sufficeth to say that in these days of increased cost and decreased efficiency of manual labor, the wise pier operator will see to it that every advantage is taken of the opportunity afforded by the output of our ingenious freight handling machinery manufacturers to perform as much as possible of the labor of handling and rehandling freight mechanically, and as little as may be manually.

Defects in Design

Without intending personal criticism of the authorities in charge of this public improvement, I am forced to the belief that this pier group has been planned with no thought of the opportunity presented by it of linking these extensive marine terminals directly to the tracks of the thirteen great trunk-line railroads which now cross the Jersey meadows immediately in rear of Staten Island; too little in accordance with the best modern conceptions of port design, and too much along the lines of former practice on Manhattan Island.

Manifestly the radically improved methods of cargo handling possible on the Staten Island shore, located on the continental side of the harbor, have been entirely overlooked in the hurry and pressure under which the Department presumably has had to provide these piers to comply with the feverish demands for additional space from intending tenants of these structures.

It may now be too late to consider the foregoing principles of design in connection with the present pier project, but for the City of New York to proceed indefinitely along these archaic lines, without reference to the keen and intelligent competition which it is meeting from other and more progressive ports on the Atlantic seaboard, would be not only incredibly stupid business policy for the municipality, but eventually will become suicidal so far as its hope of maintaining its long-continued port supremacy is concerned.

Controlling Principles Indicate Need For Wider Piers

By William S. Wilgus
Consulting Engineer, New York City

It seems to the writer that the fundamental cause for the difference of opinion as to how the Stapleton improvement should be planned lies in the conception of the purpose of the pier. In your issue of May 27, it is stated that the Dock Department "considers that the elemental function of a pier is to furnish shelter to a ship." The writer is among those who believe that its primary purpose is the affording of safe means for the economical interchange of freight between land and water carriers, and that to accomplish that object in the best manner there should be, (1) exterior tracks on the pier for the direct transfer of certain commodities (including war supplies) between ship and car, (2) ample contiguous "transit area," shedded in whole or part, for the sorting and temporary storage of cargo, and (3) interior tracks and driveways for direct interchange between the transit area, railroad cars and motor trucks.

In piers as long as those at Stapleton, 1,000 ft., later to be extended to upward of 1,300 ft., there should be two exterior tracks adjacent to each stringpiece, and not less than four interior tracks, all arranged so that the working of ship and transit area may be uninterrupted while loaded and empty cars are being shifted.

Piers Should Be 340 Ft. Wide

The transit area on each side of the pier should be sufficiently wide to accommodate modern vessels with cargoes equivalent to from 10 to 15 tons per linear foot of stringpiece, requiring from 80 to 120 ft. in width of transit area on each side of the pier, to which should be added ample driveway space for motor trucks.

To meet these obvious requirements the pier should be *not less* than 340 ft. wide.

That such a width is by no means unusual, or confined to the practice of the northwestern Pacific coast, is shown by the dimensions adopted at many Eastern ports such as Montreal, Halifax and Philadelphia, as well as at the leading European and South American ports.

Were Stapleton like Manhattan, completely severed from direct contact with the trunk lines in New Jersey, and hampered like that island with cramped quarters and congested surroundings which deny to it the promise of future relief in that respect, there would be some excuse for the modeling of the improvements at Stapleton after those in vogue in Manhattan, namely, narrow trackless piers served by lighters.

However, the circumstances are not similar. At Stapleton the waterfront, with its roomy surroundings and deep channel, is already directly in touch by rail with five of the trunk lines that serve the port, and ultimately will be connected with all of them by means of a projected outer belt line.

To ignore this difference in circumstance simply fastens on the port a continuance of the use of the "lighterage proposition," which is so largely responsible for the deserved stigmatizing of this port as "the terminal sore spot of the Nation." Whatever is done here will have a large influence on future planning at Jamaica Bay and other points on Long Island, where the opportunities for direct rail connection with the trunk lines and plenty of elbow room for expansion will be equal to those at Stapleton.

That lighterage is an evil to be avoided to the fullest possible extent is self-evident when we realize that it involves the expense and delay of two additional handlings and intermediate floatage of all freight transshipped in that manner between rail and water carriers, coupled with the enforced use of costly waterfront railroad yards and other waterfront facilities for the transferring of freight between the rail termini and the lighters. To the extent that direct contact can be established between the water and rail carriers at piers on which those agencies may meet without the interposition of lighterage, to just that extent will the port of New York be freed from the shackles which are retarding its progress.

It will therefore be seen that the wide pier with direct rail connections, ample space for sorting and temporarily storing cargo, and suitable facilities for motor trucks, will have a compelling influence on the reduction of costs and delays—a condition which must be brought about if New York is to hold its pre-eminence as the leading port of the world.

As regards mechanical equipment on the piers, it is true that there are differences of opinion, as illustrated at Stapleton itself, where one steamship interest favors the adoption of gantry cranes and another opposes their installation. Does not this conflict of judgment prove the necessity for the consideration of the matter from a broad and *disinterested* standpoint with a view to reaching a decision that will be beneficial to the port as a whole? Eventually, these piers are to revert to the city, and when that time arrives they should be adapted to the widest possible use rather than restricted to a narrow purpose.

Then, too, war necessities may arise which will impose upon these piers a duty not now contemplated by the prospective lessees. Our experience in the World War, both in this country and in France, proved the necessity for modern cranes for the speedy handling of miscellaneous cargoes direct between car and ship. In fact the experience of the army brought out very clearly the great advantage of mechanical equipment for the prompt release of vessels—a consideration of the first importance from both commercial and military standpoints. Nor should sight be lost of the need for mechanical equipment for the transferring of freight between the piers and water craft unequipped with self-handling devices, as is the case for instance with canal barges. The State of New York is spending many millions to equip its canal terminals with freight-handling devices; does it not seem curious that the City of New York should create modern water terminals and in large degree ignore that feature?

All this leads up to the point that in the designing of the piers at Stapleton, the conflicting views of the prospective lessees should not be permitted to dominate. This is a function that should be jealously retained by the city authorities whose broad knowledge of the subject, wide vision as to the future, and strength of purpose should be sufficient to plan these improvements as they should be planned, along logical lines and in recognition of the fact that the conditions which have thwarted modern development on Manhattan Island are, fortunately, absent in the case of Staten Island. That is the one borough in the city which lies west of the Hudson channel and therefore contiguous to the mainland, and which therefore is in touch with the trunk lines that connect the port with the Nation at large.

Wider Piers Necessary For Economy

By Frank G. White
Chief Engineer, Board of State Harbor Commissioners, San Francisco, California

The Staten Island harbor improvement project is of great interest to all engineers who are connected in any way with terminal development. It comes somewhat as a surprise, however, to learn that in planning "the largest steamship pier project in the history" of the city, advantage was not taken of the opportunity to develop a modern, fully co-ordinated steamship and rail terminal. Undoubtedly local conditions and local customs governing the delivery and handling of freight influenced the decision as to the plans, but it seems possible that the construction of a well-planned, fully-equipped terminal might assist in bringing about changes in these customs and a reduction in the terminal handling costs.

It would appear that piers as narrow as 125 to 130 ft. would be entirely inadequate to permit of the economical handling of cargo between ship and car, truck or lighter if the full berthing capacity of the pier is utilized. As these piers are to be from 1,030 to 1,137 ft. in length, each will berth four cargo ships having a capacity of at least 10,000 tons. At least 32 ft. of the width of the pier will be occupied by the two railroad tracks and the necessary runways for loading and unloading cars. There remains inside the shed, with no allowance for driveways, a width of not more than 82 ft. which means that the available space on the pier for handling each 10,000 tons cargo is approximately 41 x 550 ft. or 22,550 sq.ft. With a proper allowance for trucking aisles not more than 20,000 sq.ft. will be available for stacking cargo. Theoretically, this area will hold 5,000 tons of dead-weight cargo or 5,000 tons of measurement cargo stacked 10 ft. high, but practically it is very unlikely that more than one-third of a mixed cargo of 10,000 tons can be accommodated within the space available. This means that during the period of loading or discharging at least two-thirds of the cargo must be brought to, or removed from, the pier by car, truck or lighter. If adequate storage were available immediately adjacent to the pier this movement would be greatly facilitated, but the plans do not indicate that warehouses are contemplated to operate in conjunction with the pier.

In the event of railroad congestion or delays from other causes such a movement of cargo during loading or discharging would materially retard operations and delay the dispatch of the ship. Of course a large part of the cargoes are handled by lighter and will continue to be so handled but obviously rail shipments can be transferred much more economically and expeditiously by rail than by lighter. This naturally brings up the question of the proper location and arrangement of tracks on the pier.

San Francisco's Experience

Experience in the operation of the harbor of San Francisco, where practically all of the piers have direct rail connections, has proved the great disadvantage of center tracks inside the sheds. On two piers so constructed the congestion caused by cars, teams, motor trucks and hand-trucks all operating in a center driveway so detracted from their efficient operation that the inside flush tracks were removed and one depressed track was constructed along the side of each pier. Furthermore, the location of tracks along the edge of the pier permits of the direct interchange of cargo between ship and car which in many cases is a distinct advantage. Also it has been found that there is considerable economy both as regards expense and space required for the movement of freight if the tracks are depressed so as to permit of trucking into cars on the level.

The development of mechanical equipment for the handling of miscellaneous cargoes is in its infancy and the problem is not easy of solution. Many types of machines have been used and any such installation is a step in the right direction. Perhaps the most satisfactory equipment has not yet been designed but it would seem to be good judgment to construct a modern terminal so as to permit of the installation of mechanical equipment for the handling of cargo between ship and pier, on the pier itself and between pier and warehouse.

In connection with the development of a new section

of the San Francisco waterfront we are making studies which contemplate piers from 315 to 330 ft. in width. Each pier will have two separate sheds with depressed tracks between the sheds, flush tracks adjacent to the slips and provision for mechanical equipment. Ample railroad yard and warehouse facilities will also be provided.

In my opinion the two Staten Island piers which are to be 209 ft. in width, with outside depressed tracks and semi-portal cranes, will permit of greater economy in the handling of cargo and greater speed in dispatching the ship than the narrower piers with inside tracks and no mechanical equipment.

Lighterage Should Not Control New Development

BY FAY, SPOFFORD & THORNDIKE
Consulting Engineers, Boston, Mass.

Of the twelve new piers designed for Stapleton, ten are narrow, either 125 or 130 ft. in width, and the other two are 209 ft. in width. It is understood that the width of these piers was determined by the Department of Docks from the requirements of the lessee in each case. Since the method of handling cargoes from and to ships in New York harbor is at present largely by means of lighters, it has been customary to build narrow piers which serve principally as structures to which ships can tie up while loading and unloading to and from lighters, only a relatively small amount of space being available on the pier for the storage of incoming and outgoing cargoes. These narrow sheds are entirely inadequate for the storage of incoming and outgoing cargoes for ships berthed simultaneously on both sides of the piers.

The Stapleton piers differ from the Manhattan piers in that they have direct connection with a railroad, the Baltimore & Ohio, which in turn connects with all the Jersey railroads. We would expect that less freight would be handled by lighters from and to ships here than is the case with the Manhattan piers, and, therefore, more space should be devoted to the storage of cargo, to tracks and mechanical handling devices.

The narrow piers at Stapleton have no mechanical equipment for the handling of freight from and to ships other than simple cargo beams and the accompanying cargo hoists. If the greater portion of the ships docking here are unloaded and loaded to and from lighters, mechanical equipment is perhaps not so essential, as the cargo can and probably will be handled by the equipment of the lighters or of the ships themselves.

Up to the present time, it apparently has been found in New York harbor that the operating companies prefer to use the ship's tackle rather than mechanical equipment installed on the piers. The question of the use of such equipment is a matter of dollars and cents; that is, whether it costs more to pay the charges for mechanical equipment and to operate it with the resulting saving of the time the ships are in port, or to use the ships' own tackle which otherwise would be idle, and thereby lose a greater or less amount of time due to the slower loading and unloading.

With the continued improvement of mechanical handling devices and the increasing cost of labor, we expect the use of mechanical equipment for piers having ample railroad connections will materially increase in the near future.

These piers have been designed for a floor load of 500 lb. per sq.ft. and, with general package freight, would allow tiering to a height of 15 ft. more or less. This can be done economically only by the utilization of mechanical tiering equipment.

WIDER PIERS NEEDED

The New York Dock Department may be warranted, in view of the present requirements of the lessees, in building these piers substantially in accordance with the present plan. We believe, however, that where in New York harbor piers are provided with adequate rail connections, as we understand is to be the case with these piers, they will, as time goes on, obtain more and more of their freight from railroads and less from lighters and that, therefore, wider piers will be needed.

We further believe that shipping interests do not appreciate the great rapidity and convenience possible by the proper utilization of adequate equipment for the mechanical handling of freight.

In these days of high prices, inadequate and inefficient labor and frequent strikes, it would seem to be to the advantage of ship agents and operators at the port of New York to give the most thorough and scientific study possible to the utilization of mechanical equipment before determining upon the width of piers.

The question at issue appears to be whether it is best to build piers only to meet present conditions under the special requirements of particular lessees without regard to their effect on the future development of the port, or whether the problem should be attacked from the other side and piers designed as part of a permanent and comprehensive plan. The latter, we believe, to be the proper procedure.

Wider Piers Are Necessary To Handle Traffic

BY FREDERICK W. COWIE
Chief Engineer, Harbor Commissioners of Montreal, Montreal, Que.

In the course of the modernization of the port of New York, the logical, if not the only way is to bring economy of time and movement within the harbor and terminals. Lighterage in the past was developed to an unusual degree and, owing to its physical location and intense concentration on the Manhattan peninsula waterfront, lighterage was essential. The unique requirements of the Manhattan waterfront require unique facilities. Why New York design and practice, developed for its Manhattan water front and for the Long Island waterfront, where lighterage is essential, should be considered in connection with the design and practice to be adopted at the new ocean terminals at Staten Island, is incredible.

The Staten Island unit of the port of New York will be a modernized combination of ocean transportation and transcontinental railway terminals. Concentration beyond logical economic practice is not required. Twelve piers, having berths for 48 cargo ships, should result in a comprehensive self-contained port.

To be successful, this comprehensive port should be so designed that ships may arrive and clear in the shortest possible time. Even if steamship agents are

willing to lease a pier for their own exclusive use, so as to have an independent berth, it is not sound port economy to provide more berths than can be used in a more or less continuous manner.

It must be admitted that the Staten Island ocean terminals should fundamentally be designed to meet the requirements of the trade and commerce of the United States. Interior bulk of freights, inward and outward, will not or should not be handled in New York City.

To solve the transportation problem of America, railway cars must be promptly released, ships must not be detained in ports and freights must be handled economically. A pier, therefore, built for four ocean berths, should be so designed as to permit of the speedy unloading and loading of at least three ships—not one or two ships. The upper story may be used for assembling cargo: the lower deck or floor must be clear when a ship arrives.

Each berth should have an average capacity of at least 5,000 tons inward and 8,000 tons outward per week. At least 75 per cent of this may be expected to be handled by railway.

It is a demonstrated fact that in order to handle this quantity of freight, the transit sheds at each berth must have ample floor space, as it is not economical to stack freights which are to be promptly removed, to any great height. Each berth would therefore require a double-story transit shed about 500 ft. long and 100 ft. wide. With this shed accommodation, a right smart terminal railway organization must be on the job to handle cars in and out promptly. In fact the railway organization will make a good showing if they can take care of three ships instead of four, per pier per week.

Summing the matter up, a dock engineer advising on port economics will naturally insist on port facilities which should be used to at least two-thirds of capacity, while a steamship agent, whose revenues are based on a percentage of costs may not be of the same opinion. One would expect an easy decision!

250 Ft. Should Be Minimum Width

By George F. Nicholson
Chief Engineer, Port of Seattle, Seattle, Wash.

After an inspection and study of the Atlantic, Pacific and Gulf ports of North America and fully realizing the present method of freight handling necessitated by local conditions in the port of New York, I earnestly believe that the port authorities are making a grave mistake in building such narrow piers as are planned.

It is unfortunate that in so many of our ports, piers have been built the same width as quay wharves when, as a matter of fact, a pier with double the berthing space should be twice the width. The pier should be considered two quay wharfs back to back.

Although freight is transferred largely by lighters in the port of New York, why should new permanent piers be built with the view that this condition will always continue? And would not wide, commodious piers with a great amount of railroad trackage and mechanical handling equipment encourage the handling of freight direct between ship and railroad car? And even if the more modern method of freight handling does not materialize in New York for a number of years why build permanent piers now of such width that will make them obsolete when a direct-to ship-and-car movement is finally perfected?

If the absorption of port lighterage by the railroad shall be permanently prohibited by the Government, in what an unsatisfactory position will it leave the New York side of the port. Although the Baltimore & Ohio R.R. has heretofore enjoyed a monopoly of the best opportunities on Staten Island, this will not always prevail and the final solution of the problem is railroad tunnels connecting the New York and New Jersey sides of the harbor, so that eventually there will be direct-to-rail and direct-to-ship freight movement.

In my opinion the Stapleton piers should not be less than 250 ft. wide, equipped with two 2-story transit sheds and two shipside tracks on either side of pier and at least three depressed tracks in the center, this area to be paved for motor truck and team traffic.

In Seattle we are just completing the largest commercial pier in the world, it being 365 ft. wide and 2,580 ft. long, equipped with two 2-story transit sheds 130 ft. wide and on this pier alone there is 4½ miles of railroad trackage that will accommodate over 400 railroad cars at one time. This trackage consists of two shipside tracks on either side of pier and four depressed tracks in center with cross-overs approximately every 400 ft. This enormous amount of railroad trackage was decided upon after seven years' operation of a similar pier equipped with 3½ miles of railroad trackage.

Attention is also called to the fact that the Lehigh Valley R.R. is contemplating the construction of three large piers at the tide flats in the Greenville section of Jersey City on New York harbor, these piers to vary from 330 ft. to 550 ft. wide, and approximately 7,000 ft. long. The first unit of the terminal for which a 35-ft. channel is now being dredged to deep water is to be a 3,000-ft. wharf. All of these piers will have extensive railroad trackage, warehouses, and modern mechanical freight-handling equipment, and other such modern facilities.

Although conditions of freight handling vary considerably between New York and the Pacific Northwest, there is no question that New York should strive hard to bring about the direct to and from ship and to and from car movement of freight and the first step to bring that about is to build piers of adequate width and equipped with modern two-story transit sheds and sufficient railroad trackage and mechanical handling equipment in order to put into actual operation the more modern method of freight handling in connection with the operation of their marine terminal facilities.

Asphalt Production in United States

A preliminary estimate of the production and sales of asphalt and paving bitumens and allied substances in the United States in 1919, has just been made public by the U. S. Geological Survey. Asphalt produced from domestic petroleum amounted to 600,000 short tons, valued at $9,000,000, an apparent increase over 1918 of 72,425 tons and of $1,564,796, respectively. Asphalt produced from Mexican petroleum amounted to 572,000 short tons valued at $7,917,000, an increase from 1918 of 21,756, tons in quantity and a decrease of $2,407,020 in value. About 115,000 short tons of native bitumen and allied substances valued at $1,000,000 were produced in 1919, and an apparent increase over 1918 of 54,966 tons and of $219,192.

Special Impellers for Pumps in Dredging Stumpy Ground

Centrifugals on New Orleans Industrial Canal Were Rebuilt Like Wood Sewage Trash Pumps and Efficiency Increased

By Walter J. White

Formerly Superintendent of Dredging, Board of Commissioners of the Port of New Orleans; now at Covina, Cal.

About 80 per cent of the area to be excavated for the New Orleans Inner Harbor-Navigation Canal was underlaid with large cypress stumps, while for several miles there was a heavy surface growth of cypress and other timber with its accompanying roots. Notwithstanding the obvious difficulties of using a hydraulic dredge in this ground, such machines were decided upon because of the necessity of utilizing the excavated material along the banks at such a distance back as to preclude the use of dipper dredges or scow disposal. How the hydraulic dredge pumps were revamped so as to carry efficiently the matted cypress stumps and roots along with the spoil is told in the accompanying abstract of a paper presented at the last annual meeting of the American Society of Mechanical Engineers. Some changes and additions to the article as originally printed are herein incorporated by the author.—Editor.

FIG. 1. KIND OF MATERIAL PUMPED BY DREDGE "TEXAS"

FIG. 2. CANAL BEFORE DREDGING

NOTWITHSTANDING the great number and character of stumps and roots in the main section of Inner Harbor Navigation Canal at New Orleans, La. [the *Engineering News-Record*, April 22, 1920, p. 808, for description and progress report] it was decided that the work could best be done by hydraulic pipe-line dredge of the cutter type and contractors were asked to submit bids on the work. On account of the difficulties of the site, however, contract prices could not be secured and arrangements were made to charter dredges, the Board of Commissioners accepting all responsibility for output. Four 20-in. dredges and one 22-in. dredge, the "Texas," were accordingly secured and work was commenced on May 15, 1918. The dredges were powerful machines of good design in all respects, but it was fully realized that much trouble was to be expected on account of stumps and roots (Fig. 2).

By utilizing a bayou, four of the dredges were brought in to a point on the canal where one was placed in operation headed toward Lake Ponchartrain and three were started toward the Mississippi River; one dredge was also started south from Lake Ponchartrain. On account of large areas in suction and discharge pipes and pumps, the 22-in. dredge "Texas" was placed in the most difficult section. After allowing a reasonable time for dredge and crew to become adjusted to conditions, it became evident that progress would be slow and the work would be expensive, due entirely to delays and decreased capacity occasioned by stumps and roots clogging pump throat and suction. The soil itself was easily handled by a hydraulic dredge and the pipe-line conditions were not difficult, but the amount and character of roots encountered and later successfully handled is beyond description. Fig. 1 shows the character of the material actu-

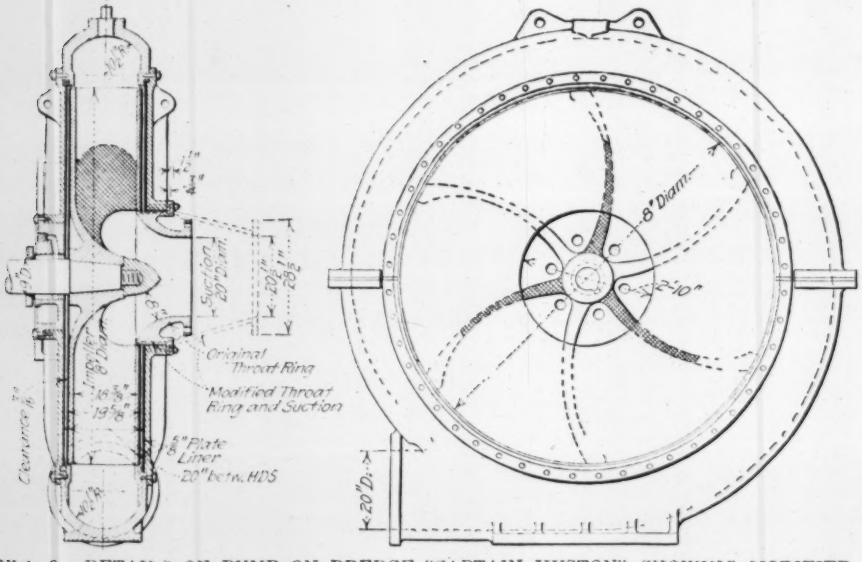


FIG. 3. DETAILS OF PUMP ON DREDGE "CAPTAIN HUSTON" SHOWING MODIFIED THROAT AND IMPELLER

...ly pumped through the dredge "Texas." It was thought that the solution of this difficulty would be found in a pump impeller designed with large and easy passage areas and having no projection webs on vanes or hub. The writer learned that A. B. Wood, mechanical engineer for the Sewerage and Water Board of New Orleans, had designed and patented a centrifugal-pump impeller for handling sewage containing trash. An impeller for a 12-in. pump was inspected, and while none had heretofore been used on dredges of the cutter type it was believed that the root problem was solved and Mr. Wood was engaged to design an impeller for the 22-in. dredge "Texas." All costs in connection with the manufacture of the impeller were to be borne by the Board of Port Commissioners regardless of whether or not it proved a success.

From the first the results obtained with the new impeller were remarkable, the increase in output being between two and three hundred per cent. The increased yardage excavated by the dredge "Texas" is shown by the following comparative statement, covering thirty days' operation immediately before and immediately after substituting Mr. Wood's impeller for the old type:

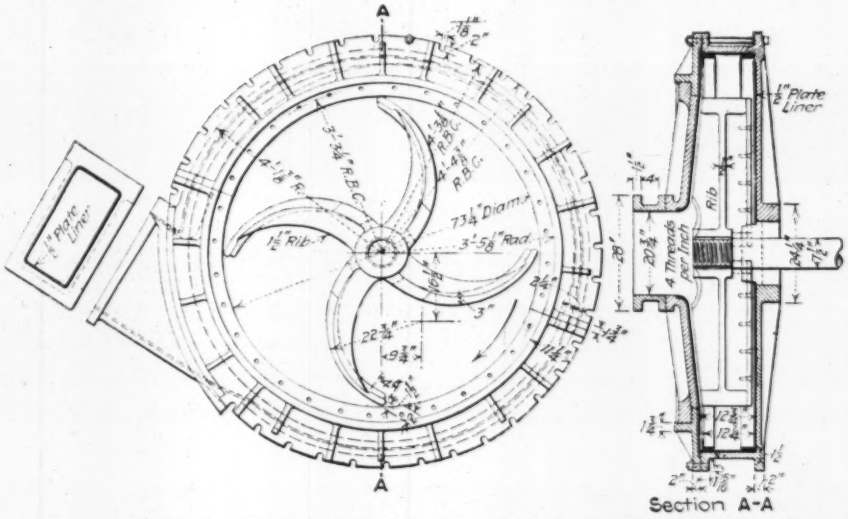


FIG. 4. DETAILS OF PUMP ON DREDGE "PELICAN" WITH IMPELLER IN PROPER POSITION

	Old Impeller	New Impeller
Excavating, hours	482 43	394 00
Clogged suction delay, hours	130 75	71 50
All other delay, hours	106 82	254 50
Advance, feet	873	2,901
Excavated material, cubic yard	73,472	175,460
Average yardage per excavating hour	152	445

The large number of delay hours after installation of new impeller was due to time lost cleaning boilers and raising a sunken fuel barge. For the period covered in the tabulation it will be seen that although the installation of new impeller decreased the number of excavating hours, the average advance and yardage was much greater. From observations of the dredge in operation it was seen that the ability of the impeller to pass stumps and roots insured the maintenance of a satisfactory output.

The operation and output of the 20-in. dredges "Captain Huston" and "Dixie" were very greatly facilitated and increased by certain modifications made in pump casings and impellers. Area in pump throat was increased by changing the shape of the throat ring and fitting a new piece of suction pipe. As previously mentioned, it was recognized that in order to secure maximum output in material of this character, it would be necessary to provide as large passages through pump and impeller as possible, and it was therefore determined that two-thirds of each alternate vein should be cut out of the impellers in these dredges, as shown in Fig. 3. The outer one-third of the vanes was left to preserve structural strength, but after observing the performance of the pumps it is the opinion of the writer that every alternate vane could have been entirely removed.

During the first three days that the dredge "Captain Huston" was in operation and prior to making alterations to the pump the yardage output of the dredge was practically nothing. This was due to the fact that the pump suction throat was continuously clogged with stringy roots and stumps, which it was impossible for the pump to handle. Conditions could not have been worse and it was felt that any method whereby the pump throat and impeller could be opened up would result in increased output. It is admitted that some uneasiness was felt as to how these alterations might affect the performance of the pumps, but results have more than justified what at first seemed to be a drastic and hazardous measure. Pump and engine tests have shown that these alterations did not affect the capacity or efficiency of the pump, other than by greatly facilitating the passage of roots, etc., through the pump. While the writer understands that radical alterations should not be made without careful consideration, it is undoubtedly true that the performance of a dredge is to be judged largely, if not solely, by the unit cost of output, and where

FIG. 6. SIDE VIEW OF SPECIAL IMPELLER FOR DREDGE "TEXAS"

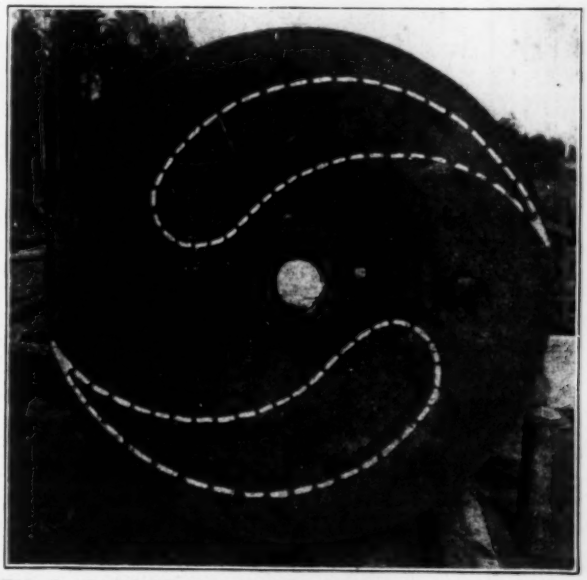


FIG. 5. BACK OF TWO VANED IMPELLER DESIGNED BY A. B. WOOD FOR 22-IN. DREDGE "TEXAS"
Foot measure alongside. Dotted lines show shape of vanes.

TABLE I. DATA AND RESULTS OF TESTS OF CENTRIFUGAL DREDGING PUMPS

Test Number	Steam Pressure, Lb. Sq.In. Gage	R.P.M.	Suction, Ft. of Water	Discharge, Ft. of Water	Total, Including Difference of Velocity Heads	Flow in Ft. per Sec. by Venturi Meter	Indicated Hp.	Water, Hp.	Combined Efficiency, Engine and Pump	Peripheral Speed, Ft. per Sec.
			Texas							
			Feb. 14, 1919							
1	175	201	— 0.94a	76.02	77.03	20.16	423.4	175.8	41.5	70.16
2	175	201	+ 0.86a	99.34	98.48	0.0	254.45	0.0	0.0	70.16
3	173	202	—12.94	57.57	71.18	58.37	742.5	471.0	63.3	70.51
4	170	240	— 1.34a	112.04	113.47	22.86	681.9	293.0	43.0	83.78
5	175	244	+ 0.86a	145.29	144.43	0.0	403.4	0.0	0.0	85.18
			Captain Huston							
			Feb. 23, 1919							
1	200	141	—30.20	25.82	54.26	52.38	657.9	322.1	49.0	59.06
2	198	161	—15.23	85.11	99.56	35.17	706.7	397.8	56.3	67.44
3	200	165	—12.74	93.65	105.69	33.05	729.5	396.0	54.1	69.12
4	200	166	+ 0.28a	99.89	99.61	0.0	292.7	0.0	0.0	69.54
5	191	168	—10.06	98.96	108.49	28.87	682.8	355.8	52.1	70.38
6	200	174	—10.97	104.97	115.33	30.78	742.8	403.0	54.3	72.95
7	200	182.5	— 6.56	123.67	129.88	23.47	756.8	346.0	45.7	76.48
8	200	184	— 6.40	122.22	128.27	23.47	759.6	341.7	45.0	77.0
9	200	221.5	+ 0.28a	186.94	186.66	0.0	426.0	0.0	0.0	92.78
			Dixie							
			Mar. 11, 1919							
1	158	158	—25.99	28.52	54.70	49.55	559.55	307.50	55.0	57.91
2	155	160	—22.98b	34.27	57.42	46.62	568.83	303.71	53.4	58.64
3	150	163	— 7.68	58.36	66.10	27.29	446.78	204.66	45.8	59.74
4	156	163.5	—18.48b	44.22	62.85	42.0	551.42	299.56	54.3	59.92
5	145	166	— 8.16	60.21	68.44	27.81	471.47	215.94	45.8	60.84
6	152	174.75	— 9.32	66.68	76.08	30.35	545.4	261.8	48.0	64.05
7	155.7	175.5	—10.74	64.71	75.54	32.33	577.42	277.25	48.0	64.32
8	154.5	176	— 2.68a	76.37	79.08	17.85	479.15	160.15	33.5	64.50
9	156	176	— 0.03	78.91	78.95	8.95	407.72	80.11	19.65	64.50
10	156	176.5	+ 0.92a	82.61	81.79	0.0	310.24	0.0	0.0	64.68
11	151	186	— 3.60	83.76	87.40	19.47	547.96	193.06	35.3	68.17
12	150	197	— 0.38a	99.46	99.85	10.21	552.39	115.66	20.95	72.20
13	154	219	+ 0.82a	127.17	126.35	0.0	578.31	0.0	0.0	80.26
			Pelican							
			May 28, 1919							
1	174.5	119.5	+ 3.99	8.93	23.16	30.06	139.95	78.9	56.3	38.06
2	175	132	—17.40	10.58	28.26	32.90	184.33	105.2	57.2	42.04
3	175	145	—21.96	11.78	34.10	37.04	246.10	143.0	58.1	46.18
4	182.5	145	+ 0.88a	41.45	40.57	0.0	75.66	0.0	0.0	46.18
5	175	146.5	—10.96	16.63	35.90	34.58	231.32	140.3	60.7	46.65
6	180	148	— 3.87a	36.38	40.32	16.61	162.82	76.0	46.6	47.14
7	175	149	+ 0.28a	42.88	42.61	5.74	117.93	27.7	23.5	47.46
8	180	150.5	— 1.57a	40.06	41.67	11.99	147.15	56.6	38.5	47.93
9	182.5	159	—11.34	34.03	45.55	25.96	236.30	133.8	56.7	50.64
10	182.5	164	—12.91	35.03	48.14	28.01	249.94	152.8	61.2	52.23
11	182.5	177	— 7.66	51.68	59.45	20.93	272.30	140.8	51.75	56.37
12	177.5	184	— 4.0	60.61	64.69	15.97	276.22	117.0	42.4	58.60
13	175	186	— 2.82a	63.63	66.51	14.65	286.53	110.2	38.5	59.24
14	175	199	+ 0.08a	76.78	76.71	6.79	283.2	59.0	20.75	63.38
15	177.5	217	+ 0.88a	99.41	98.53	0.0	295.22	0.0	0.0	69.11
			Pelican							
			May 31, 1919							
			During this test the runner was reversed							
1	175	118	—13.49	7.98	21.69	28.85	151.78	70.9	46.75	37.58
2	176	137	—19.67	10.53	30.52	35.1	255.12	121.3	47.6	43.63
3	189	141	—21.75	11.28	33.39	36.9	288.57	139.3	48.35	44.91
4	172.5	142	—17.53	15.08	32.89	32.85	256.88	122.3	47.7	45.23
5	177.5	146	— 3.93a	31.88	35.88	16.65	154.56	67.70	43.8	46.50
6	175	146	+ 0.88a	37.98	37.10	0.0	75.85	0.0	0.0	46.50
7	175.5	147	— 1.13a	36.68	37.84	10.60	138.93	45.5	32.7	46.82
8	172.5	148	+ 0.88a	38.18	37.30	0.0	79.48	0.0	0.0	47.14
9	172.5	150	+ 0.64a	40.08	39.44	3.76	106.66	16.78	15.73	47.78
10	181	152	—10.63	28.58	39.38	25.90	233.58	115.3	49.4	48.41
11	181	159	—11.84	31.18	43.22	27.54	266.79	134.7	40.55	50.64
12	177.5	182	— 7.14	50.18	57.44	21.38	307.91	139.0	45.2	57.97
13	187.5	199	— 3.88a	64.88	68.83	16.49	321.50	128.5	40.0	63.38
14	181	209.5	+ 0.88a	79.68	78.80	0.0	194.58	0.0	0.0	66.73
15	180	218	+ 0.88a	87.83	86.95	0.0	227.89	0.0	0.0	69.43
16	170	221.5	— 0.43	88.78	89.23	8.17	327.96	82.50	25.18	70.55
17	185	224	+ 0.88a	90.58	89.70	0.0	243.34	0.0	0.0	71.34
18	185	244.5	+ 0.88a	109.78	108.90	0.0	334.57	0.0	0.0	77.87
19	185	249	+ 0.88a	113.58	112.70	0.0	354.46	0.0	0.0	79.31

a Readings of suction gage incorrect because of whirl set up in pipe by pump impeller.

b Suction readings incorrect, due either to pet cock being throttled down too much or getting temporarily choked up.

DISCHARGE-PIPE-LINE CONDITIONS FOR TESTS OF DREDGING PUMPS GIVEN IN TABLE I

Texas: Tests 1 and 4, 8-in. valve on end of discharge pipe wide open. Tests 2 and 5, 8-in. valve on end of discharge pipe cut off. Test 3, pipe line 570 ft. pontoon and shore pipe.

Captain Huston: Test 1, Pipe full opening. Test 2, Iron plate bolted on discharge pipe. Tests 3, 7, and 8, 8-in. valve on end of discharge pipe wide open. Tests 4 and 9, 8-in. valve on end of discharge pipe cut off. Tests 5 and 6, Pipe line 3,538 ft. pontoon and shore line.

Dixie: Test 1, Pipe full opening. Test 2, Wooden piece bolted on discharge pipe. Tests 3, 5, and 6, Pipe line 1,583 ft. pontoon and shore pipe. Test 4, 2 pieces of wood bolted on end of discharge pipe. Test 7, Iron plate bolted on end of discharge pipe. Tests 8 and 11, 8-in. valve on end of discharge pipe wide open. Tests 9 and 12, 8-in. valve on end of discharge pipe partly closed. Tests 10 and 13, 8-in. valve on end of discharge pipe cut off.

Pelican: Tests 1, 2, and 3, Pipe full opening. Tests 4 and 15, 8-in. valve on end of discharge pipe cut off. Tests 5 and 10, Wooden piece bolted on end of discharge pipe. Tests 6 and 11, 3 wooden pieces bolted on end of discharge pipe. Tests 7 and 14, 8-in. valve on end of discharge pipe partly closed. Tests 8, 12 and 13, 8-in. valve on end of discharge pipe wide open. Test 9, 2 wooden pieces bolted on end of discharge pipe.

Pelican (with reversed runner): Tests 1, 2, and 3, Pipe full opening. Test 4, Wooden piece bolted on end of discharge pipe. Tests 5 and 12, 3 wooden pieces bolted on end of discharge pipe. Tests 6, 8, 14, 15, 17, 18 and 19, 8-in. valve on end of discharge pipe cut off. Tests 7 and 8 8-in. valve on end of discharge pipe wide open. Tests 9 and 16, 8-in. valve on end of discharge pipe partly closed. Tests 10 and 11, 2 wooden pieces bolted on end of discharge pipe.

In all cases where length of discharge pipe is not given the length was less than 100 ft. from the stern of dredge. In general figures in Table I are a mean of a number of readings recorded during tests, which explains why the figures are worked out to two decimal places. The venturi meter had an inlet diameter of 22⅝ in. and a throat diameter of 18 in. For readings at cut off, the elevation of water at rest in suction pipe was taken as suction head and for other readings of low quantity the suction head was taken from loss pressure curve plotted from high quantity readings.

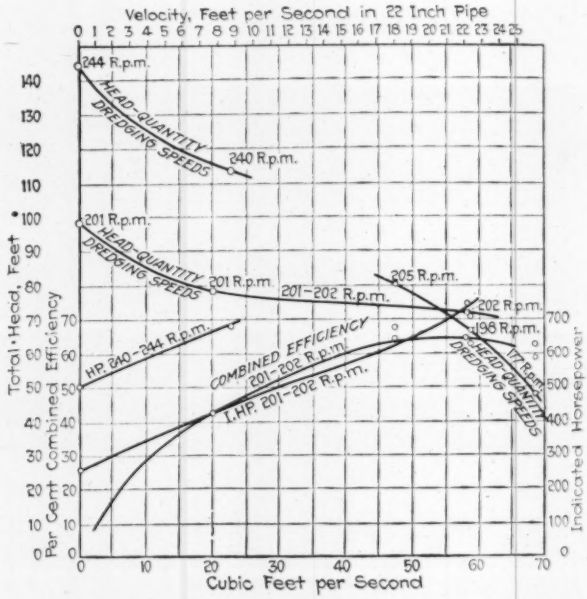


FIG. 7. PERFORMANCE CURVES OF DREDGE "TEXAS" EQUIPPED WITH PUMP IMPELLER DESIGNED BY A. B. WOOD

TABLE II. DATA ON CENTRIFUGAL DREDGING PUMPS

	Texas	Capt. Huston	Dixie	Pelican	Pelican †
Diam. of impeller, in	80	96	84	73	73
Number of vanes	2	3*	3*	4	4
Diam. of suction pipe at suction gage, in	23½	19¾	20⅝	20½	20½
Diam. of discharge pipe at discharge gage, in	22¼	20¾	20⅝	25½x12½	25½x12½
Triple expans. engine, in	14x21½x35	14½x22½x40	14½x22½x36	11⅛x18x29	11⅛x18x29
Length of stroke, in	18	20	18	18	18
Water at rest in canal above center-line of pump, in	10½	3½	9½	.....	.....
Water in river above center-line of pump, in	.....	.....	.....	10½	10½
Zero of suctiongage below center-line of pump, in	19	20	16.68	1.68	At center line of pump
Zero of discharge gage above center-line of pump, in	20	.....	.....	7	7
Zero of discharge gage below center-line of pump, in	.....	53½	47.66	.....	.....

* Originally 6, parts of 3 vanes removed. † This test made with impeller reversed.

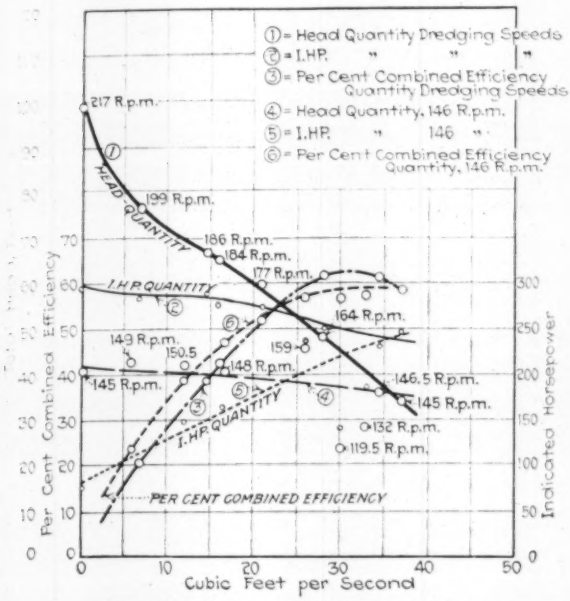


FIG. 8. PERFORMANCE CURVES OF PUMP OR DREDGE "PELICAN"

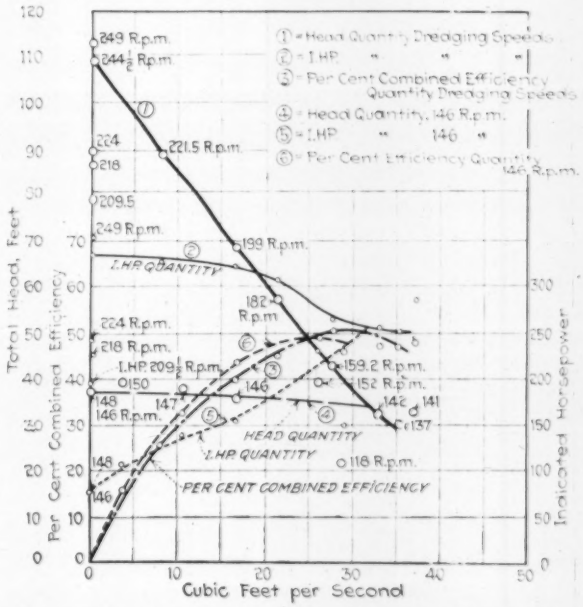


FIG. 9. PERFORMANCE CURVES OF "PELICAN" WITH REVERSED IMPELLER

for any reason output is not being secured any modifications of plant are justified, provided that the unit cost of output is controlled. In this particular instance there was involved the difference between failure and success. Assuming the same general character of excavation, a further modification along the lines indicated would, it is believed, result in a further increase in output.

The impeller designed for the 22-in. dredge "Texas" was of same diameter (80-in.) as that of the old impeller, but it had two instead of four vanes. An examination of Figs. 5 and 6 will show that due to the peculiar shape of vane, the lodging or collection of roots or other material is made difficult, if not impossible, every encouragement being given by shape of vane and throat of impeller to the continuous flow of water containing irregular shape roots or other objects. The writer does not wish to convey the impression, however, that all of the large cypress stumps and roots were cut up by the cutters and handled through a 20- or 22-in. dredging pump. While suction ladders were built for heavy service and cutters were of good design and powerful, a great many of the stumps were undercut and allowed to sink to the bottom, where they were deposited below grade.

In general the operation and maintenance of the dredges followed the usual procedure for dredges of this type. The 22-in. dredge "Texas" was equipped to use ball joints as connections between sections of pontoon pipe, and it is believed that the passage of roots was made easier than if rubber sleeves had been used.

Pump impellers having two, three, four, six, and seven vanes and varying in diameter from 68-in. to 96-in. were used in the different dredges engaged on this work. Tests to determine certain centrifugal dredge-pump characteristics while pumping water were carefully made. The results of these tests are given in Tables I and II. Observers were selected and were rehearsed several times to make sure that they understood just what was required of them. All practicable precautions were taken so that accurate results would be secured. Readings were recorded as observed, the object being to eliminate any intention to interpret or analyze readings while test was in progress. A study of the readings does not reveal any wide range in any set of readings for a given condition. All the figures in Table I are a mean of a number of readings and the writer has confidence in the correctness of all observations and computations, and it is believed that the data presented will be of value in analyzing and studying the design and performance of centrifugal dredging pumps. At the time tests were made, the dredges were in good operating condition, but no special preparation of machinery was made. All of the pumps tested were of the single suction type and all impellers, with one exception, were shrouded on both sides. The pumps were directly connected to vertical triple-expansion engines.

Upon the completion of the tests made on the dredges "Captain Huston" and "Dixie" both of which were equipped with pumps having modified propellers, it was decided to test the pumps of the dredge "Pelican" which was fitted

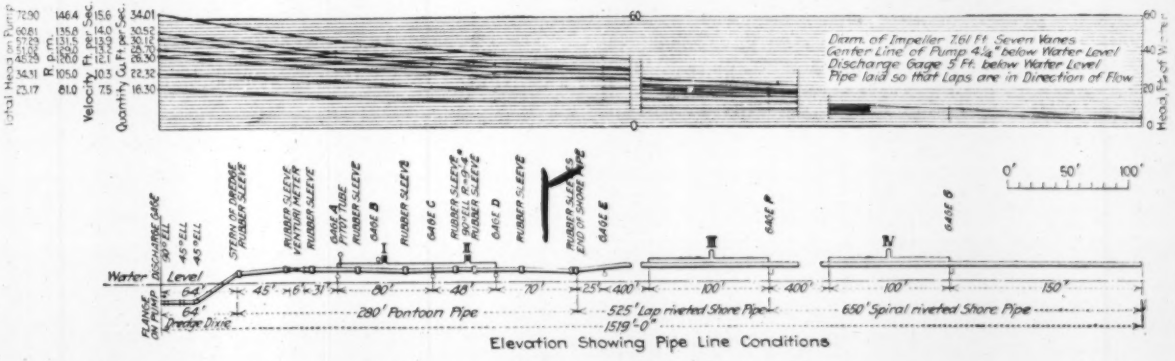


FIG. 10. LOSS OF PRESSURE TEST ON 20-IN. DREDGE "DIXIE"

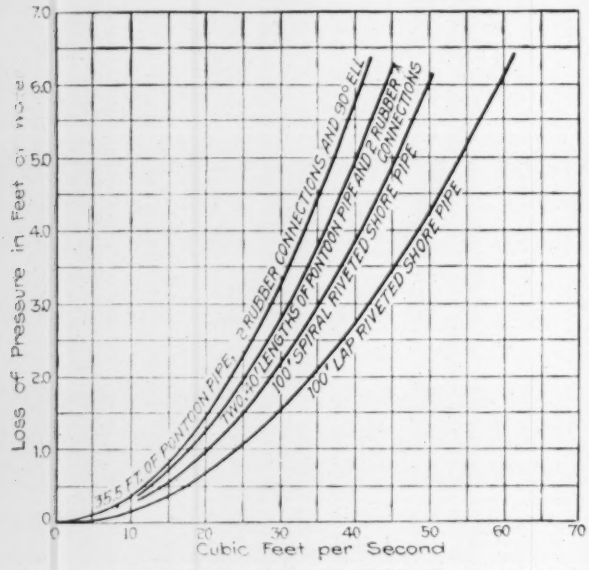

Loss of Pressure in Feet of Water
Cubic Feet per Second
35 FT OF PONTOON PIPE, 2 RUBBER CONNECTIONS AND 30° ELL
TWO 20' LENGTHS OF PONTOON PIPE AND 2 RUBBER CONNECTIONS
100' SPIRAL RIVETED SHORE PIPE
100' LAP RIVETED SHORE PIPE

FIG. 11. LOSS OF PRESSURE PLOTTED TO DISCHARGE ON "DIXIE"

with an open impeller. This pump, shown in Fig. 4, was tested with impeller in the pump in the normal manner with the vanes curved backward and also with the impeller reversed, i.e., with the vanes curved in the direction of rotation. The results were surprising and are shown in detail in Table I and the curves of Fig. 8 and 9. So far as the operation of the dredge was concerned, both while pumping water and also while dredging, there was nothing to indicate to the closest observer that the pump was not assembled in the usual manner. After completion of tests it was found by comparison that there was a 10 per cent loss of efficiency due to increased consumption of power with the reversed impeller. As a matter of interest it might be stated that the dredge "Pelican" was operated from June 1 to June 14, 1919, with the reserved impeller, nothing unusual being noticed in operation and no diminution in yardage being apparent.

Pressure Drop Tests

In the tests of dredges "Texas" and "Captain Huston" the quantity of water discharged by the pump was measured by pitot tube and venturi meter. While testing the dredge "Captain Huston" the pitot tube was bent and was not used in the tests of the other dredges. During tests the venturi meter was located just astern of the dredge in a straight section of pipe, where it would not be influenced by elbows. Suitable arrangements were made so that the discharge pipe could be throttled, or closed off entirely, and in this way a variation in head and quantity was created. Piezometers were ¼-in. tee-handled pet cocks, which were screwed into the pipe. Indicators were not calibrated, but are believed to have been in excellent condition. Cards were taken simultaneously on the three-engine cylinders.

It was unfortunate that during the drop in pressure test (shown in Figs. 10 and 11) made on the dredge "Dixie" it was impossible to obtain comparable peripheral speeds due to valve of intermediate cylinder being improperly set.

In a hydraulic pipe-line dredge of the cutter type it is believed that all passages through pipes and pump should be designed so that clogging at any point by more or less irregularly shaped solids will be reduced to a minimum. As a result of tests and also based on observation of the dredges in operation, it is the conclusion of the writer that the modifications described did not decrease the efficiency or capacity of the main engines and pumps, but did greatly increase the output of the dredges as excavating machines.

States Absorb All 1920 Federal-Aid Highway Funds

On June 16 the last plans and estimates needed to insure that every cent of Federal-aid funds which had to be taken up prior to July 1 would be taken up, were received and approved by the chief engineer of the Bureau of Public Roads. Not only have all the funds available during the fiscal year of 1920 been obligated by the various states, but eight states have applied for their share of Federal-aid which must be applied for by July 1, 1921. The Bureau of Public Roads is now giving attention to the construction of more than 18,000 miles of improved highways included in 1,800 projects.

Following is the status of Federal aid as of June 16, 1920:

STATUS OF FEDERAL AID FUNDS ON JUNE 16, 1920

State	Funds Which Must Be Taken Up Prior to July 1, 1920	Funds Obligated by Plans and Estimates Approved by Chief Engineer of the Bureau of Public Roads	Balance to Be Taken up Prior to July 1, 1920	Funds Which Must Be Taken up Prior to July 1, 1921	Balance Which Remains of Funds to Be Taken up Prior to July 1, 1921
Alabama	1,676,167.27	1,714,967.74	0	3,671,669.07	1,956,701.33
Arizona	959,097.68	970,074.38	0	2,397,707.53	1,427,633.15
Arkansas	1,338,315.29	1,301,127.53	0	2,934,751.38	1,633,623.85
California	2,433,607.29	3,060,552.46	0	5,329,679.06	2,269,126.60
Colorado	1,375,920.25	1,450,904.21	0	3,024,304.97	1,573,400.76
Connecticut	492,552.43	981,823.05	0	1,075,975.27	94,152.22
Delaware	130,349.56	284,980.01	0	284,980.02	.01
Florida	912,449.89	1,476,917.40	0	2,002,664.56	525,747.16
Georgia	2,152,942.64	4,067,844.55	0	4,710,427.66	642,583.11
Idaho	974,371.32	1,003,107.46	0	2,134,338.93	1,131,231.47
Illinois	3,506,652.82	10,484,154.61	0	7,659,199.06	.00
Indiana	2,163,392.46	2,330,279.49	0	4,728,239.34	2,397,959.85
Iowa	2,316,226.61	5,318,649.70	0	5,058,014.40	.00
Kansas	2,295,068.00	4,888,460.41	0	5,024,064.45	135,604.04
Kentucky	1,562,265.53	1,614,538.20	0	3,418,309.36	1,803,771.16
Louisiana	1,086,908.29	1,918,464.93	0	2,380,293.44	461,828.51
Maine	771,393.47	1,056,827.77	0	1,685,733.41	628,905.64
Maryland	697,750.11	1,691,116.43	0	1,523,750.46	.00
Massachusetts	1,179,698.00	1,600,470.81	0	2,579,776.26	979,305.45
Michigan	2,319,921.34	3,309,422.02	0	5,069,627.58	1,760,205.56
Minnesota	2,273,822.10	3,662,728.41	0	4,973,293.69	1,310,565.28
Mississippi	1,434,957.40	1,590,182.62	0	3,143,985.12	1,553,802.50
Missouri	2,713,079.31	3,049,093.49	0	5,934,176.11	2,885,082.62
Montana	1,592,849.60	1,508,854.18	0	3,491,837.18	1,982,983.00
Nebraska	1,706,399.75	3,451,947.98	0	3,733,019.68	281,071.70
Nevada	1,029,358.18	1,081,665.09	0	2,250,931.75	1,169,266.66
New Hampshire	333,410.35	790,690.56	0	728,250.06	.00
New Jersey	949,046.06	1,454,849.23	0	2,077,742.57	622,893.34
New Mexico	1,273,633.77	1,307,676.17	0	2,791,326.76	1,483,650.59
New York	3,989,791.41	4,213,480.30	0	8,716,908.56	4,503,428.26
North Carolina	1,825,679.69	3,127,560.01	0	3,991,636.88	864,076.87
North Dakota	1,226,375.37	1,256,560.95	0	2,686,259.90	1,429,698.95
Ohio	2,973,222.17	5,446,803.36	0	6,496,700.90	1,049,897.54
Oklahoma	1,844,961.83	1,889,799.50	0	4,035,767.27	2,145,967.77
Oregon	1,259,853.95	3,320,163.83	0	2,756,026.23	.00
Pennsylvania	3,678,154.13	9,624,353.12	0	8,040,698.24	.00
Rhode Island	186,500.46	403,834.79	0	407,909.26	4,074.47
South Carolina	1,147,734.06	1,538,526.76	0	2,510,598.46	972,071.70
South Dakota	1,134,842.29	1,155,215.65	0	2,837,103.60	1,681,887.95
Tennessee	1,815,227.44	2,683,406.00	0	3,966,224.08	1,282,818.08
Texas	4,095,133.88	4,162,884.20	0	10,238,806.31	6,075,922.11
Utah	909,205.72	985,775.02	0	1,987,630.72	1,001,855.70
Vermont	362,650.02	476,240.16	0	792,026.64	315,786.48
Virginia	1,589,155.85	2,250,133.01	0	3,474,056.45	1,223,923.44
Washington	1,154,550.27	3,365,604.27	0	2,527,048.04	.00
West Virginia	851,534.38	2,008,040.76	0	1,862,351.68	.00
Wisconsin	2,040,736.93	2,208,988.16	0	4,459,335.32	2,250,347.00
Wyoming	980,308.68	1,447,678.68	0	2,144,842.33	697,163.65

Cost of Railroad Stationery

Vice-President T. C. Powell has recently compiled some figures on the Erie's expenditures for rails and stationery from 1915 to 1919, inclusive, as follows:

Year	Stationery	Rail	Rail Price Per Ton
1915	$403,125.20	$660,386.00	$30.00
1916	395,980.10	872,410.00	31.50
1917	560,565.83	658,839.00	31.50
1918	497,933.36	889,292.00	40.80
1919	541,474.55	781,143.00	40.80

It will surprise many employees to know, as these figures demonstrate, that stationery calls for such enormous outlay; and it will help to justify the efforts we have been making to convince employees who use paper and other articles included under the heading of stationery, that the subject is deserving of all the attention it is receiving.—*Erie Railroad Magazine.*

Motor Operation Costs as Affected by Highway Location and Grade Design—Part II

Value of Eliminating Rise and Fall by Cut and Fill Construction Discussed — Simple Case of Farm Wagon Trailer Train Explained

By Wilson G. Harger
Former Senior Highway Engineer, U. S. Bureau of Public Roads

A CLOSE analysis of the effects of distance, rise and time on the cost of motor operation is desirable but hardly possible yet. With the great variety of cars, trucks, and other vehicles operating under different degrees of efficiency it is hopeless to arrive at very definite conclusions. General principles based on the laws of mechanics can be derived, but actual definite costs are another matter and the author frankly leaves their determination to someone in the future. Long alternate routes can be advantageously compared in value for the elements of distance, rise and time, but the value of a close operating cost analysis of grade line design has a very limited application as previously discussed. The time element has not much practical value on short trips as we all waste considerable time during the day, but on commercial hauling routes it plays a noticeable part in the cost and for this reason we have analyzed some of the problems in two ways. As a matter of general interest the following approximate data are included. These data have been used by the author personally for some time, but merely as a basis for judgment.

We all have heard the cost of tires, repairs, gas, etc. talked by the hour for the ordinary pleasure car. Each reader probably has his own data but we will assume that the total operating cost on hard surfaced roads in 1919 for the ordinary passenger car, including interest on investment, depreciation, insurance, repairs, gas, oil, storage, etc., runs from 5c. to 12c. per mile. Assume 8c. as an average, and that of this amount gas and oil cost 2½c., assuming 14 mi. per gallon.

We will assume that 5-ton trucks cost about $28 per day to operate; that the total cost of operation will run from 30c. to 50c. per mile. These trucks get about 3 to 5 mi. on a gallon of gas and the cost of fuel will be assumed at 8c. per mile. Two-ton trucks under similar conditions probably cost about $20 per day to operate or about 30c. per mile with a fuel cost of say, 5c. per mile.

It can be seen that the cost of fuel is only a small percentage of the operation of a truck.

Value of Distance Saved

Traffic counts, or the general character of territory served by the road in question, can be used as a rough guide as to the probable proportion of horse traffic, passenger cars and trucks. Taking the ratios of traffic for the main roads of Massachusetts we get the following average saving in operation cost per vehicle for a saving of 1 mi. of distance:

Horse traffic	6% of total	6 x 3c. per mile	= $1.80
Light cars	87% of total	87 x 8c. per mile	= 6.96
Trucks	7% of total	7 x 35c. per mile	= 2.45
	100%		$11.21

Then, $\frac{11.21}{100} = 0.11$, or 11c. However we will assume the financial saving to be 10c. per vehicle on a saving of 1 mi. in distance for main traveled roads.

These data agree with the assumptions of A. R. Hirst given in Part I of this article. Table No. I in Part I of this article assumes average going and does not consider various rates of grade. It includes the time factor and is intended for the comparison of long routes or special service commercial roads. If used as a basis for estimating the value of saving distance on a local service road it is just as well to divide the figures by two. The figures previously given may be summarized by the statement that the capitalized value of saving 1 foot of distance amounts to approximately $14 for a volume of traffic of 100 vehicles per day.

Value of Rise Saved

The elimination of needless rise and fall between terminals providing the distance is not increased is evidently valuable. There are so many indeterminate factors that in this discussion we will take refuge in simple theoretical mechanics using the simplest data available and then modify the results arbitrarily. The tabular results given (Table II) have been used by the author in the absence of reliable data as a rough guide in comparing cut and fill grade reductions. The time factor is not considered as it does not have much real practical value for short grade changes. Time is, however, very noticeable on long steep climbs. For comparing total rise and fall on long routes it is better to use Table III as this considers the time factor.

If a car started at A from rest and there was no rolling resistance, no air resistance, no friction of any kind, no loss of energy from the engine running while coasting down the grade from C to B or from the application of brakes while descending from C to B, the potential energy of the vehicle at the top of the hill C would be equal to the energy in ft. lb. required to

TABLE II. CAPITALIZED VALUE OF SAVING 1 FT. OF RISE AND FALL WITHOUT INCREASING DISTANCE

(Based on fuel cost of 2.7c. per mile on the level)
(Time factor not considered)

Average No. of Vehicles per Day	Yearly Saving 10% Grade	Yearly Saving 6% Grade	Yearly Saving 2% or Less	5 Per Cent Capitalized Value 10% Grade	5 Per Cent Capitalized Value 6% Grade	5 Per Cent Capitalized Value 2% or Less
100	$7.55	$5.10	$1.10	$151	$102	$22
250	18.90	12.75	2.75	378	255	55
500	37.75	25.50	5.50	755	510	110
750	56.65	38.25	8.25	1,133	765	165
1,000	75.50	51.00	11.00	1,510	1,020	220
2,000	151.00	102.00	22.00	3,020	2,040	440
3,000	226.50	153.00	33.00	4,530	3,060	660
4,000	302.00	204.00	44.00	6,040	4,080	880
5,000	377.50	255.00	55.00	7,550	5,100	1,100
10,000	755.00	510.00	110.00	15,100	10,200	2,200

NOTE.—This table can be used as the extreme basis of cut and fill reductions on local service roads.

TABLE III. CAPITALIZED VALUE OF SAVING 1 FT. OF RISE AND FALL WITHOUT INCREASING DISTANCE

(Based on a car-mile operating cost of 11c. on average grades)

(Time factor included)

Average No. of Vehicles per Day	Yearly Saving — Grades			5 per Cent Capitalized Yearly Saving — Grades		
	10%	6%	2% or Less	10%	6%	Less than 2%
100	$21	$14	$3	$427	$275	$60
250	52	35	7	1,067	687	150
500	105	70	15	2,135	1,375	300
750	158	105	23	3,202	2,062	450
1,000	210	140	30	4,270	2,750	600
2,000	420	280	60	8,540	5,500	1,200
3,000	630	420	90	12,810	8,250	1,800
4,000	840	560	120	17,080	11,000	2,400
5,000	1,050	700	150	21,350	13,750	3,000
10,000	2,100	1,400	300	42,700	27,500	6,000

NOTE:—This table can be used for the comparison of long routes or indicates about the maximum allowable expenditure for cut and fill reduction on special service commercial roads. Considering the fact that extra fuel and gas means very little to most road traffic ¼ of these values would be a liberal expenditure at the present time for such refinements.

haul it up the hill from A to C and the kinetic energy at B would be the same due to its speed developed by coasting. Under these theoretically perfect conditions no energy is required to move the load from A to B on the level. The energy in ft. lb. per ton of load would be $2{,}000 \times 100 = 200{,}000$. If the car was stopped at B by braking, this energy would be lost and the total energy expended would have been 200,000 ft. lb.

In a similar way the energy expended over the same hill cut down 10 ft. to C' would have been $2{,}000 \times 90 = 180{,}000$, or number of foot pounds. The saving in energy resulting from cutting down the hill 10 ft. is 20,000 ft. lb. or 2,000 ft. lb. per ton of load per foot of rise saved provided the car is stopped at B. In case the car is not stopped at B and the coasting cars partially climb another hill beyond B on their own momentum there is no saving at all accomplished by cutting down the hill shown from C to C' as the car having a kinetic energy of 200,000 ft. lb. will go farther on its own momentum than the one having a kinetic energy of 180,000 ft. lb.

The introduction of friction and rolling resistance merely adds a constant loss of energy in the normal grade direction which is practically the same in amount no matter how much the hill is cut down as the difference in the distances $A\ C\ B$, $A\ C'\ B$ and $A\ B$ is not appreciable for ordinary road grades.

As a matter of fact the cars are rarely stopped at the bottom of each hill and it is evident that the saving in expended energy due to grading down a knoll depends on how much of the potential energy at C or C' is lost in descending the grades $C\ B$ or $C'\ B$. That is, if half the potential energy is lost through braking, an actual saving of 1,000 ft. lb. per ton of load results from cutting down the hill one foot. If three-fourths of the potential energy is wasted a saving of 1,500 ft. lb. results, etc.

Simple Case Explained

Suppose we carry through a simple case of a farm wagon trailer train starting from rest at A. Full power is applied climbing $A\ C$ and the energy used per ton of load is 2,000 lb. × total rise in feet plus the rolling resistance in pounds per ton of load x distance travelled in feet. The potential energy of the train at C per ton of load equals 200,000 ft. lb. and the energy used in overcoming rolling resistance is a dead loss and equals 40 lb. (rolling resistance per ton of load from table 1) x distance $A\ C$ in feet. In a similar way the potential energy at C' equals 180,000 ft. lb. per ton of load and the energy lost in overcoming the rolling resistance is the same as the first case.

In descending the hill from C to B or C' to B practical wastes of the potential energy occur through keeping the engine running while coasting; through the application of brakes to control the speed on steep grades or through throwing the engine into second or low gear and keeping it engaged to act as a brake. Rolling resistance also eats up its regular supply of energy. On low grades no shifting of gears occur as a rule nor is the engine thrown out, the driver merely cuts down his gasoline and takes advantage of the gravity help. *That is, there is less potential energy wasted on a light grade than on a heavy grade. This is the principle we wish to develop as it indicates that from a practical standpoint the actual saving in operation cost for eliminating a foot in rise and fall over a hill, is less important on light grades than on heavy grades.* Professor I. O. Baker developed this same general principle in the third edition of his book published in 1918. This adds a certain theoretical strength to the contention that for light intermediate grades there is very little advantage to traffic through cutting the top of every knoll and fiilling every hollow.

For purposes of a rough approximation we will assume that 80 per cent of the potential energy is lost on a 10 per cent grade; 50 per cent on a 6 per cent grade and 10 per cent on grades of 2 per cent and less. This is based on the assumption that on a level the rolling resistance per ton is 40 lb. and that on a 10 per cent grade the rolling resistance plus gravity = 240 lb. per ton. The down hill gravity pull amounts to 200 lb. per ton, 40 lb. of this is effective in overcoming rolling resistance. We probably lose by brake action $200 - 40 = 160$ lb., or $\frac{160}{200} = 80$ per cent plus engine running waste say 2 per cent = 82 per cent. This is arbitrarily reduced to 80 per cent. In a similar way the other two values are derived modified by the probability that less brake action and engine loss occur on the 6 per cent grade. Theoretically, no loss occurs on grades of 2 per cent or less on the basis of a 40-lb. rolling resistance but we have assumed a loss of 10 per cent as a common sense value.

The theoretical potential energy per foot rise per ton is 2,000 ft. lb. The loss on these grades would therefore be for a

10% grade	80% loss of 2,000 ft. lb.	= 1,600 ft. lb.
6% grade	50% loss of 2,000 ft. lb.	= 1,000 ft. lb.
2% grade or less	10% loss of 2,000 ft. lb.	= 200 ft. lb.

If we assume that the rolling resistance of the farm wagon trailer on a level road is 40 lb. per ton we can convert the saving of energy per foot rise into equivalent distance.

$$1 \text{ ft. rise on } 10\% \text{ grade} = \frac{1{,}600 \text{ ft. lb.}}{40 \text{ ft. lb.}} = 40, \text{ number feet of level distance}$$

$$1 \text{ ft. rise on } 6\% \text{ grade} = \frac{1{,}000 \text{ ft. lb.}}{40} = 25, \text{ number feet of level distance}$$

$$1 \text{ ft. rise on } 2\% \text{ grade} = \frac{200}{40} = 5, \text{ number feet of level distance}$$

Assumng an average fuel cost for all classes of traffic on the road at 2.7c. per car per mile on the level the fuel cost per 100 ft. of rise care becomes.

$$\text{On a } 10\% \text{ grade } \frac{4,000}{5,280} \times 2.7\text{c.} = 2\text{c.}$$

$$\text{On a } 6\% \text{ grade } \frac{2,500}{5,280} \times 2.7\text{c.} = 1.4\text{c.}$$

$$\text{On a } 2\% \text{ grade } \frac{500}{5,280} \times 2.7\text{c.} = 0.3\text{c.}$$

Using these figures we can compile a table of capitalized value at 5 per cent for saving 1 ft. of rise without increasing distance. This table has some value as indicating about the extreme expenditure that is justified for the elimination of needless rise and fall by grading down small hills by cut and fill on local service roads. It does not consider the time factor of operation as this has little practical bearing on minorchanges in rise because there is a certain amount of time wasted during the day anyway. However, this factor becomes very noticeable on long, steep climbs and should be considered in comparing long routes, special service hauling roads or in making radically different relocations. (See Table III, p. 172.)

In order not to lose the sense of value of any such figures it is just as well to bear in mind that the American public is not particularly careful of small savings. The average motor car is not kept in a high state of efficiency. If the owner himself does not think it worth while to save gasoline by keeping his car in shape how can we expect the community at large to make heavy appropriations for construction features whose values are based on purely theoretical small additional savings. There is undoubtedly more gasoline wasted from careless upkeep and driving than we could ever save by the refinements of scientific location and the author is not inclined to give such analyses much weight except as they indicate general principles.

(To be Continued.)

Railway Access to Large Ports

Increase of railway facilities at some of the large French ports during the war, in order to provide for prompt handling of the great volume of military material and supplies, included the construction of loop or belt lines to give at least two independent connections with the main lines. This scheme of two-way access to the ports was provided not only to increase the traffic capacity but also to prevent the possible blocking of traffic in the event of a derailment or other accident or the destruction of the tracks by enemy airships. At both Calais and Dunkerque, for example, two or more railways converged upon a line leading into a single terminal station, while branches extended to the docks and waterfront. Any accident on the approach to the station would have stopped all railway traffic. In each case the plan adopted was to connect the dock branches with a new outside line passing around the city and effecting a junction with the several main lines. At Dunkerque four lines were built to complete a connected system. Another advantage of these belt lines was that of keeping much of the traffic clear of the city terminals, the material being moved directly to yards on the belt lines and there held in cars or in storage ready for forwarding when required. These railway auxiliary or relief works, which will form permanent additions to the transportation facilities, are described in the *Revue Generale des Chemins de Fer* by M. Moutier, assistant chief of operation of the Nord.

Chicago Double Deck Street for Congested District

Traffic Separation Is Main Purpose—Automobile Parking Space, Wharfage and Freight House Facilities Included

A WIDE double-deck water-front street extending along the bank of the Chicago River is not only to form a new thoroughfare and relieve traffic congestion, but is also to have the unusual features of providing wharfage for vessels and facilities for handling railway freight. This project is one of the important municipal works for which bonds were authorized by the voters of Chicago last fall, and is an item in the broad scheme of municipal improvement prepared under the direction of the Chicago Plan Commission. The commission submitted the original designs to the Arnold Co., engineers, Chicago, for review, particularly with regard to the transportation features, since the importance of the project lies in its varied relations to the local transportaion problem. The following matter is prepared mainly from an extended report by J. R. Bibbins, supervising engineer of the company.

The South Water St. improvement will extend for seven blocks, or about 3,500 ft., as shown by the sketch and plan, Figs. 1 and 2. It will commence at the east

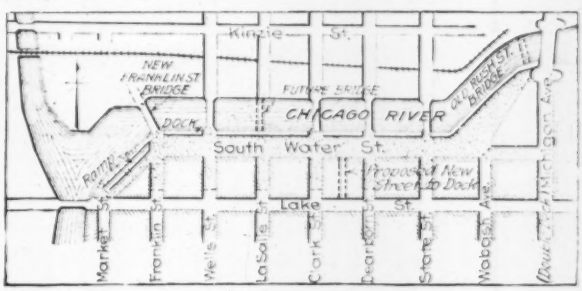


FIG. 2 PLAN OF NEW WATER FRONT STREET

end by a connection with the double deck thoroughfare and bridge completed recently at Michigan Ave., and will terminate at Lake and Market Sts., where an incline is to connect the end of the upper deck with the lower street level. This upper deck will cross the approaches to bridges on six North-and-south main streets serving the central district, and being above the present street level it will permit of giving easier grades upon these approaches.

The improvement will eliminate a congested district which is now occupied by old buildings on both sides of the street and along the river front. This district is utilized as an elongated market for meat, poultry and garden produce. Delevopment of inland navigation, with Chicago as an important gateway, is considered as a possibility and is provided for by the continuous dock front with wharfage and warehouse space. Extension of the marginal street southward along the east bank of the river is recommended, but the double-deck feature might not be required for that future portion of the improvement.

Several purposes will be served by this double deck street. In the first place it will give a new east-and-west thoroughfare of large traffic capacity on the margin of the congested "loop" or central business district, connecting with a number of north-and-south streets, so that it will serve to distribute the traffic at

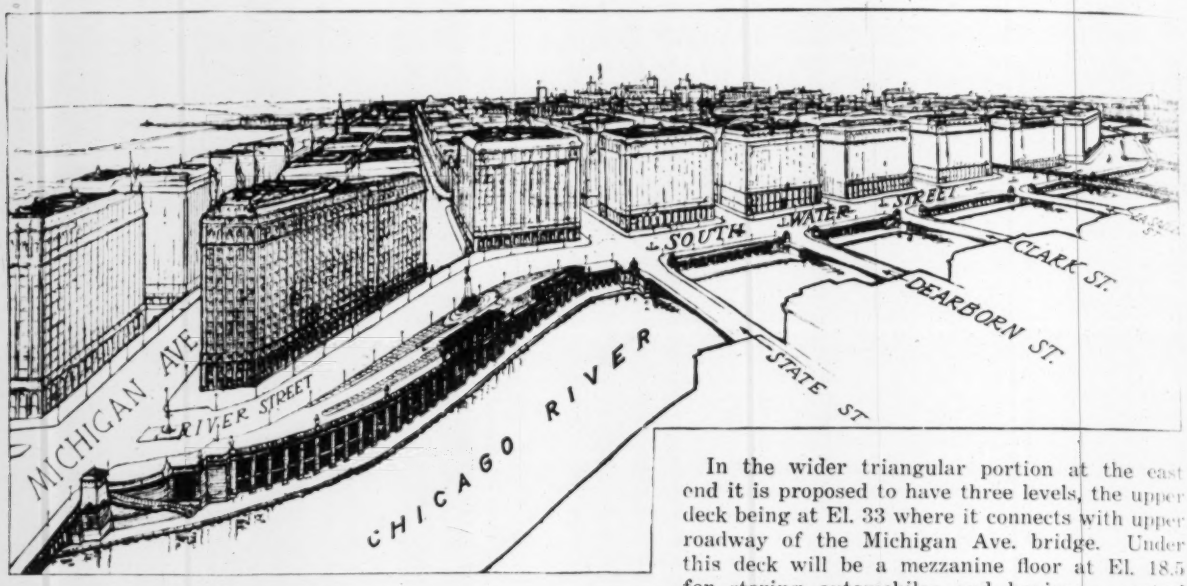


FIG. 1. RIVER FRONT OF SOUTH WATER STREET IMPROVEMENT, CHICAGO

several gateways and will serve also as a needed bypass for much heavy traffic which now has to cross the loop. It will avoid interference of through east-and-west trucking traffic with normal north-and-south traffic over the river bridges. It will also provide extensive freight handing facilities convenient to ships, barges and railway terminals. In addition to increased traffic capacity and the separation of fast and slow traffic, auxiliary advantages include the provision of parking accommodation for automobiles, delivery of freight to buildings on both levels, the increase of local property values and business facilities, the establishment of a continuous line of dock or wharf for water craft, and the removal of the present unsanitary market which blockades a public street.

On the upper level is to be a street 110 ft. wide with a 75-ft. roadway about 21 ft. above the water level of the river (Chicago datum), while the present street elevation is about 14 ft. above datum. This upper deck is for automobiles and through traffic. All intersecting streets will rise to the new elevation by ramps of easy grade on the south side, the north approaches being nearly level with the bridges. The lower level is to be 5 ft. above the water and will project beyond the upper deck so as to form an open wharf or dock space 25 ft. wide, which will be accessible to all abutting property. The typical design is shown by the cross section, Fig. 2.

As the lower deck will be below the street level it will be approached only at the ends, except that near the middle it is proposed to cut a new connection sloping up from the dock level to the normal street level, as shown by the plan. In the covered portion will be four bays forming two roadways for motor truck and wagon traffic, an inner space for wagons backing up to the doors of business houses, and an outer space for parking automobiles or for wharfage. It is estimated that the two roadways will give capacity for 8,000 vehicles each way in an 8-hour day, assuming a speed of 4 m.p.h., or 5,000 vehicles at the slowest vehicle rate of 2½ m.p.h.

In the wider triangular portion at the east end it is proposed to have three levels, the upper deck being at El. 33 where it connects with upper roadway of the Michigan Ave. bridge. Under this deck will be a mezzanine floor at El. 18.5 for storing automobiles and having a central ramp or incline of about 5 per cent grade to connect with the upper roadway. The lower level, at El. 5, will form a municipal dock and warehouse and also a union less-than-carload freight station connected with the existing underground narrow-gage freight transportation system of the Chicago Tunnel Co. A similar station at the west end would be located in the basement of the adjacent building, so as to avoid interference with the through roadways in the event of their extension southward. At each station there are to be elevators and surface tracks for the small tunnel cars, the tracks being on a platform at El. 8.5. The two stations will have a daily capacity for handling 400 and 600 tons respectively. Street cross sections at these stations are shown in Fig. 3.

Ventilation of the lower deck is thought to be necessary owing to the vitiation of air by exhaust gases from motor vehicles and to the fact that this covered portion 110 ft. wide will be closed along the inner side. Gratings in the sidewalk and in safety islands in the roadway are proposed, with an alternative plan for grated openings under the overhanging edge of the sidewalk. On the river side will be arched openings between the columns. The structural design has not been decided upon, but probably concrete piers will form the foundations. Inclined approaches on the south side will be fills with concrete retaining walls, except that they may be utliized partly for storage space. Galleries for the wires, conduits and pipes of public utilities are provided, as shown by the drawings.

Street Traffic Conditions

Improvement of traffic capacity in and around the loop district of Chicago is of particular importance in view of the exceptionally congested and restricted conditions of the district, which has an area of only 0.66 sq. mi. Although this extreme centralization of business is very objectionable, and is detrimental to the proper development of the city, there is little prospect of enlargement of the business center prior to the construction of rapid-transit subways.

Many of the streets in the loop district are narrow and it has only 17 gateways, of which six are on the

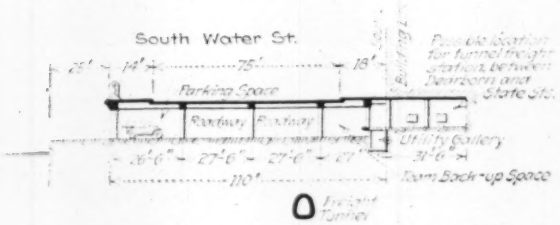


FIG. 3. TYPICAL CROSS-SECTION OF DOUBLE DECK STREET

north side, and most of these routes have the disadvantages of river drawbridges with inclined approaches. Owing to the elevation adopted for the new river-front street, the bridge approach grades will not exceed 3 per cent. It is suggested in the report, however, that each approach should be broken by a short and nearly level stretch on the south side of the new street, even at the expense of lengthening the approach, as this will facilitate the starting of heavy street cars and vehicles when the traffic signal is given.

Nearly 60 per cent of all loop traffic (trucks, teams and automobiles) is to and from the north side, the figures for one day in 1916 showing 15,000 passenger vehicles and 12,000 commercial vehicles. During the same time 5,000 commercial vehicles moved east and west in the first three streets south of the river (South Water St., Lake St. and Randolph St.)

In addition to this heavy and intersecting traffic condition, the loop district is surroundet by steam railways, with freight houses and yards, resulting in an enormous cross traffic of heavy trucking between the various railway and commercial facilities. This condition will be relieved materially by the new street, which will not only enable a large proportion of the traffic to pass around the loop but will keep this by-pass traffic clear of intersecting traffic and out of the path of fast traffic moving in the same direction overhead. It is estimated that without this separation there would be 4,000 freight vehicles crossing the path of 13,000 through vehicles every day.

Of equal importance will be the relief afforded for the automobile traffic, which already is a serious problem in the loop. The main relief will be in distributing the heavy north-side traffic over several gateways, while at present over 75 per cent is handled at one gateway and there is no broad thoroughfare to permit of distribution. Further there will be a route for through movement between the north and west sides of the city without crossing the loop. A traffic census made in 1917 (*Engineering News-Record*, Feb. 17, 1918, p. 254), showed 49,621 automobiles entering and leaving the loop in 12 hours, 15,634 of these being on the north side and 77 per cent of the latter using Michigan Ave.

A large proportion of these automobiles stop in the loop and form a serious hindrance to traffic. From the census noted above it appeared that of 6,000 automobiles coming from the north side in one day, 4,500 were destined to points within the loop and that 2,900 of these were parked at least one hour. A count made by Mr. Bibbins in 1916 showed that over 66 per cent of the parked vehicles in the loop remained over an hour and the majority were on streets having car lines. In spite of city regulations, the parking of cars in the streets is an exceedingly troublesome factor in the municipal transportation problem.

Provision of storage or parking accomodation for automobiles at points closely adjacent to the lop is highly desirable, but it is difficult to find available space.

The South Water St. improvement will help to remove this difficulty by providing space for 300 machines on the mezzanine floor at the east end (adjacent to the heaviest traffic gateway) and for 225 machines along the lower level.

Freight Handling Tunnels

For the handling and transfer of local freight Chicago has the unique advtanage of an extensive system of tunnels, although this system has been worked as yet only to a small porportion of its ultimate capacity. It is the utilization of this underground line in connection with the new street, for the double purpose of facilitating the handling of freight and reducing the congestion of street traffic in the business district, that forms one of the important features of the Arnold report. In other words, the street improvement is taken advantage of as an opportunity for improving the entire local freight service of the city.

About 1,800 tons of L. C. L. freight are handled daily by the tunnel system, which serves railway freight houses, large wholesale and retail establishments, warehouses and other points. This tonnage is less than 10 per cent of the total outbound freight traffic of the rail-

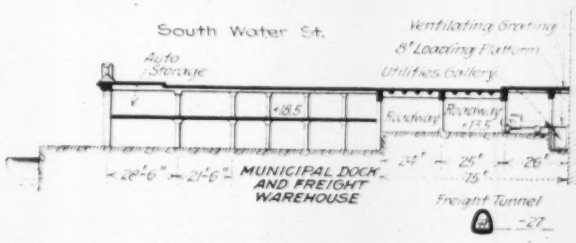


FIG. 4. TRIPLE DECK PLAN GIVES PARKING SPACE

way downtown freight houses, but the report states that with some improvements and with proper co-operation of all interests it could handle probably 10,000 tons daily. Even with 2,000 tons daily the importance of the underground transportation is shown by the fact that this amount would require from 750 to 1,000 trips of motor trucks daily, or 90 to 125 round trips per hour during an 8-hour day. This business would require 250 to 300 more vehicles on the streets, and most of their movements would cross the busy loop district.

Alternatives to the tunnel system for handling the local freight are motor trucks, railway trap cars and river lighters. Trucks will tend to a continual increase in traffic congestion, besides increased cost of street paving and maintenance. Trap cars are a necessary evil, but their use involves delay and expense. Lighters could serve only the relatively small proportion of freight area located along the waterways of the city.

The South Water St. improvement is one feature of the "Plan of Chicago" conceived some years ago by the late Daniel H. Burnham and now supported actively by the Chicago Plan Commission. General designs have been made by Edward H. Bennett, consulting architect for the commission. Detail plans are being prepared by C. D. Hill, engineer of th Board of Local Improvements, which board will carry out all the legal, technical and construction work.

Chart Records of Excavating Machine Operations

TO DISCOVER the rates of speed and the time consumed in the several operations of machine excavators with a view to determining their effectiveness, George B. Massey, consulting engineer, Chicago, has made experiments with autographic apparatus designed by him for the purpose.

The recording instrument, Fig. 1, consists of a series of pens electrically connected to contacts on different parts of the machine and tracing lines or diagrams upon a 5½-in. strip of paper traveling vertically over rollers. The paper is long enough for a record of 90 to 180 minutes and is moved by clockwork at the rate of 6 to 12 in. per minute. Steel fingers on fiber board bases form the contacts with the moving parts, being supported usually on brackets secured to foundation bolts. In this way a rigid attachment can be arranged without difficulty.

For tests on a dipper dredge, six diagrams were drawn recording the performances of: Dipper thrusting engine, swinging engine, direction of swing, hoisting and backing and revolutions of main engine. For a tower type of machine, with a dragline bucket carried by a cable between two towers, the diagrams showed the following: Revolutions of main engine, revolutions of track cable sheave, hauling of loaded bucket, movement of track cable for dumping, backhaul. Samples of these charts are shown in Fig. 2 and 3, the originals being taken with the paper moving at the rate of 8½ in. per minute. Additional pens with automatic or hand operated connections could be used to record coal and water consumption, travel of the machine and the cause of delays.

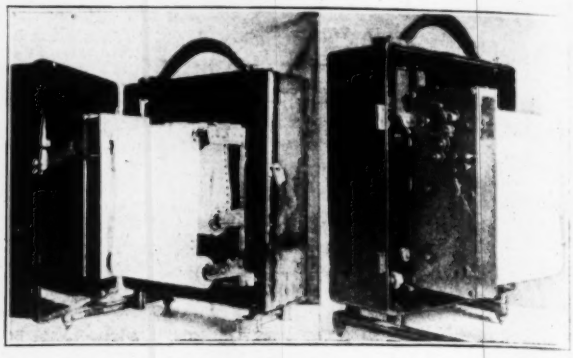


FIG. 1. RECORDING DEVICE FOR EXCAVATING MACHINE

On the dipper dredge, contacts attached to the clutch levers of the hoisting and backing drums indicated when they were operating at the same speeds as their shafts. A contact on the reverse lever of the swinging engine indicated the direction of swing. Thus the position of the boom and the path of the dipper could be plotted and the acceleration of the hoisting, backing and swinging movements could be ascertained. A dipper dredge is apt to roll when the boom swings, especially if the soil makes it difficult to keep the machine pinned up. This may affect the acceleration of boom swinging and could be recorded. It would be desirable also to record the instant when the dipper handle assumed a vertical or horizontal position, as this would give for each cycle a point from which the position of the dipper could be ascertained.

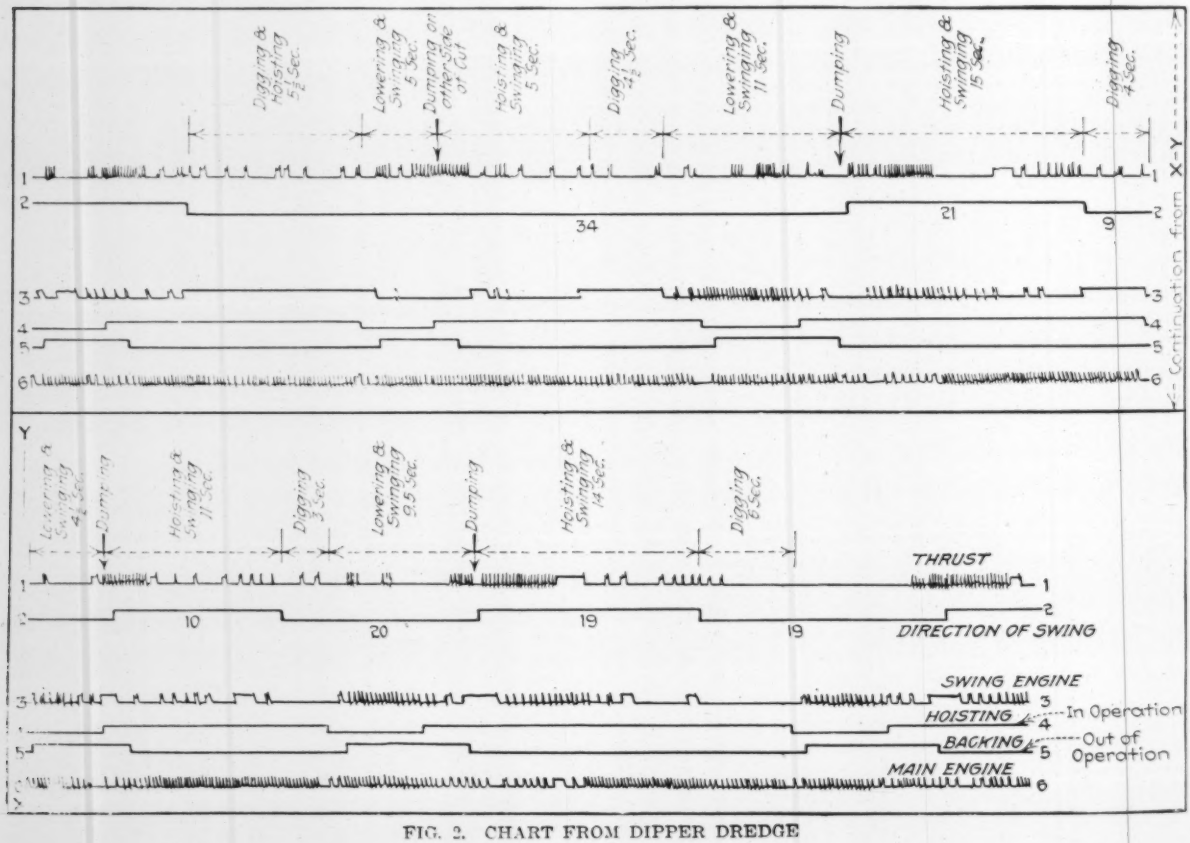


FIG. 2. CHART FROM DIPPER DREDGE

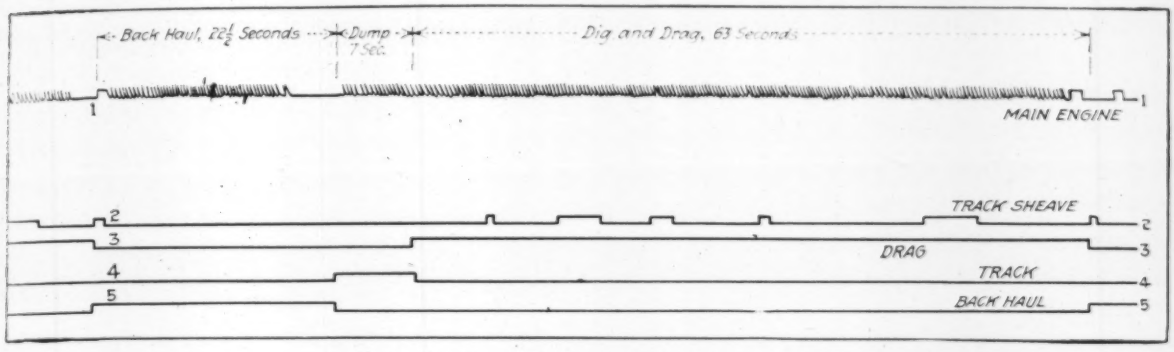


FIG. 3. CHART FROM DRAGLINE EXCAVATOR

An interesting feature in the tests of the dredge was the difference in the records of several operators. With the same yardage one man operated the machinery more smoothly than the others, thus saving in repairs, steam and coal. The only difference in operation was a slightly smaller opening of the throttle valve and the lapse of a little more than a second in throwing the clutches.

In the tower excavator, all the drums were driven by one engine and one contact recorded the revolutions of the crankshaft, the drum speed being determined by the gear ratio between the crankshaft and each drum shaft. A contact on each clutch indicated when the drum was driven and released. To record the speed of paying out the track cable to dump the bucket, a contact was operated by one of the spokes of the sheave when the sheave moved in the paying out direction.

Long Aerial Cable Tramway in the Northern Andes

Country Too Rough for Railway Building Crossed by Line to Mountain City—Maximum Span 3,168 ft.—Steam Power

CONSTRUCTION of a 45-mile aerial cable tramway forming the extension of a mountain railway is being carried out to connect Manizales, Colombia, with the end of the Dorada Railway at Mariquita. The city of Manizales, with a population of 35,000, is the center of a rich agricultural district at an elevation of nearly 7,000 ft. in the northern Andes, but it is accessible only by rough mountain trails. Mule teams can make the 45-mile trip in 2½ to 3½ days in summer, but in the rainy season the trip may take two weeks. As a result the loss and damage to goods in transit is considerable. According to an article in *The Engineer* of London, from which this information is taken, the loss on coffee has amounted to 10 per cent of the total shipments.

Four intermediate villages have to be served by the cable tramway and this condition governed the general route, but surveys for location were hampered seriously by the prevalent and long continued fogs. At one point the line spans a valley only about a mile wide at the top but so steep and precipitous that mule teams take about eight hours for the crossing.

Starting at Mariquita with an elevation of 1,500 ft., the line will rise to a summit of 12,000 ft. in 32 miles, thence descending in 13 miles to an elevation of 6,700 ft. at Manizales. The alignment is fairly straight and includes only five angle stations. The line will be divided into fifteen sections, the longest being 19,000 ft. with a difference in elevation of 787 ft. In the shortest section 8,528 ft., the difference in elevation is nearly 1,312 ft.

For supporting the cables there will be 437 steel towers from 10 to 217 ft. in height, but only two will be of the maximum height and only eight over 130 ft. The longest span between towers is 3,168 ft., but there will be sixteen spans of more than 1,640 ft. Both three-post and four-post towers are used. A wire rope of 2⅜ in. circumference, with a breaking load of 30 tons, forms the track cable and runs over 24 in. sheaves carried by cross arms on the towers. Tension stations are provided to adjust the sag of the track cable to the load carried. The carriers or buckets take normal loads of 670 lb., occasionally as high as 1,120 lb., and travel at a speed of about 400 ft. per minute. The plant is designed for a traffic of 20 tons per hour from Manizales, and 10 tons per hour from Mariquita, but the first installation will be for half this capacity.

Steam plants will be provided in 30-hp. units with boilers adapted for brush fuel and 120-lb. working pressure. At stations where greater power is required, two units will be installed. There will be 20 stations in all, including driving and tension stations. Warehouses into which the carriers will run will be provided at the terminals and at four intermediate points.

Construction was commenced in 1913, the first 10-mile section being opend in 1915, and the adjacent 11-mile section in 1916. War conditions then interfered with the work, but early in 1920 the line had been completed for 23 miles and further construction was in progress. Engines and boilers were shipped in sections of not over 1,120 lb. and most of the cases weighed only about 220 lb. For mule transport the cables were put up in coils of 100 lb. each, with a loose stretch between, each mule carrying two coils. The line is owned by the Dorada Railway Co. (Ropeways Extension), for which Sir Douglas Fox & Partners, London, are the consulting engineers. The Ropeways Co., London, has the contract for equipment and construction.

Water Supply of New Zealand's Capital

The City Council of Wellington, New Zealand, has decided to expend about $500,000 in cutting two tunnels through the hills near the city to bring water from the Orongorongo River, with the additional expenditure of $1,119,295 for extra mains and other expenses to provide a water supply sufficient for a city of 130,000 people. The present population of Wellington and its suburbs is about 95,000.—*Commerce Reports.*

Simple Solution for Finding Center of Gravity of Trapezoid

By Jacob London
New York City

THE problem of finding the center of gravity of a four-sided figure graphically often arises. The solution which I am submitting is simpler than those given in handbooks and especially handy when the shape of the figure is to be determined by a cut-and-dry method, as in the design of buttresses, retaining walls, and small gravity dams.

The principle of construction is briefly this: by means of a diagonal divide the four-sided figure (Fig. 1) into two triangles with centers of gravity at M and N. The center of gravity of the entire figure must lie at a point C somewhere on the line MN. The area of the triangle "N" times MN must equal the area of the entire figure times MC. Call the intersection of MN and the diagonal, A. The triangles have a common base. Their areas are proportional to their altitudes or to the segments MA and AN. The total area is proportional to MN.

$$\text{Then } AN \times MN = MN \times MC$$
$$\text{and } MC = AN$$

In practice the top and rear face of the wall or dam are fixed, arbitrarily. The slope of the front face and

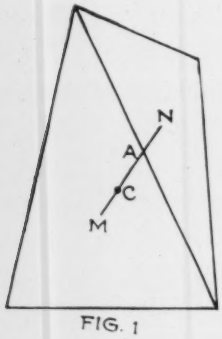


FIG. 1

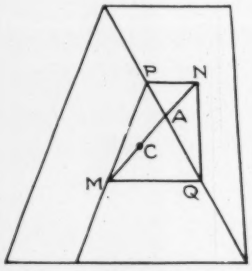


FIG. 2

the width of the base vary with the forces acting. Thus, two adjacent sides are fixed and a diagonal may be drawn. Divide the diagonal into three equal parts (Fig. 2), P being the upper third point and Q the lower. Draw PN parallel to the top and QN parallel to the rear face giving N, the center of gravity of one triangle. Draw a line through Q parallel to the base. All the lines drawn so far are independent of the slope of the front face.

To find the center of gravity of the cross-section for some particular front face draw a line through P parallel to the front face. (The intersection of this line with the base gives the limit of the middle third which is useful.) The intersection of the line with the line through Q, parallel to the base gives M, the center of gravity of the second triangle. Draw MN getting A. Lay off AN along MN from M which gives C, the center of gravity of the cross-section.

If a new front face be tried it is only necessary to draw two new lines PM' and NM' to get the new center of gravity and the diagram is not confused by their addition. Other methods necessitate the erasure of all the old construction lines when a new front face is considered.

Basis of Estimating Allowance for Depreciation

What Is Proper Method of Accounting in Respect to a Valuation for Purposes of Rate-Making?

By William G. Raymond
Dean, College of Applied Science, State University of Iowa

IN A depreciating property furnishing service of any kind, one of the items of cost of service is depreciation allowance, set out from year to year in a depreciation reserve. As valuations are usually made in rate cases the reproduction cost of the property at the time of valuation is estimated, the amount of accrued depreciation is estimated with the reproduction cost as a base, and as an item of the operating expense the annual depreciation allowance is estimated on the same base. The purpose of this paper is to inquire whether or not this is proper practice.

What is it that is chargeable as a cost of service? What is it that the public enjoying that service is under obligation to pay with respect to this item of consumption of capital? Is it the cost of the item in use or the cost of the item that replaces it when it is worn out? Is it the investment that is to be protected by making an allowance for depreciation, or is it the physical thing that was purchased with that investment that is to be protected? That is to say, is it the cost of the item that is to be returned to the owner when the item is worn out, or is it another item of like kind, or for a like purpose that is to be furnished him?

The Wrong Basis

It is thought to be, without question, correct bookkeeping and in accordance with the requirements of public commissions—where these commissions have made requirements—that when an item is discarded its cost is credited to capital, and the cost of the item that replaces it is charged to capital. This seems to be a rational procedure.

But now let it be supposed that instead of charging off the old item at cost, no entry is made in the capital account, but the cost of the new item is treated as an operating expense, which the public is expected to pay, because the public should pay operating expense, and that a valuation of the property to determine fair rates occurs shortly after the replacement. The time since the replacement may be supposed to be so short that in fixing prices of the various items of property the price of the particular item under question will be its actual cost, and let it be supposed that that cost is double the cost of the item that it replaced. Thereafter the public will be expected to pay interest on this double cost after having itself, through its contribution to operating expense, paid half of the cost, that is to say, it will be paying interest on the contribution of the owner and interest on its own contribution as well. Is this right?

But let it be supposed that the cost of the second item is only half the cost of the item that it replaces. The public then will be expected to pay interest on half the cost of the original item, and the owners original investment will have been cut in two. He will henceforth receive interest on only half as much as the invested originally in this item of the plant. Is this right?

It may be said that the results above indicated will have been due to a charge in the value of the dollar and that since the working item is made good in kind the value of the property as a working property is maintained, that the value of the investment is maintained as it was in the beginning, as was required by the U. S. Supreme Court in the Knoxville Water Works decision. But is this true?

Maintaining the Investment

The change in the price of a single item in a large going property may not be due to a change in the purchasing price of a dollar, but may be due to a change in the market price of the particular item. Let it be supposed that an item of presumably long life, purchased and put into service in a going plant, is destroyed by accident shortly after its purchase, but that in the meantime the price of the item, and therefore the cost of replacing it, has changed materially. This is not a violent assumption. Shall the public be expected to pay the additional cost of the new item over the one it replaces, if any, or the owner be expected to lose from his investment the difference between the cost of the old item and that of the new if the new one costs less than the old?

Manifestly either procedure would seem to be unfair, and from this somewhat extreme, but possible example, it would seem to be reasonable to conclude that when a public utility property is created, it is not the physical property items that the public should undertake to maintain, but rather the investment in that property. And if the owner receives a fair return rate on the money that he invests in the various items of a public service property, while these items are in existence, and receives back what he paid for them when they go out of existence, and further receives a fair return on the cost of the items that replace the original items, whether this be less or more than the cost of the original items, is he not receiving his just due, and is not the public paying its fair charge?

If this conclusion is sound, then the annual depreciation allowance that is included in operating expense should be based upon the cost of the depreciating item, and not on the cost of the item that is to replace the depreciating item. As a rule this cost of the replacing item cannot be known in advance of its purchase, so that it is impossible, even if it would be just, to base the depreciation allowance for a given item in use on the cost of the item that is to replace it.

And again, if the conclusion is correct, then it is equally improper to base the depreciation allowance on the cost of reproduction of the property as of the time of a valuation. Rather should the depreciation allowance be based upon the estimated or known original cost to date, and this is true regardless of whether original cost to date or reproduction cost as of the date of valuation, or any other estimate is used for determining the value of the property at a given date.

The position taken by the Committee on Valuation of the American Society of Civil Engineers, appointed to formulate principles and methods for the valuation of railroad property and other public utilities, is strictly in accord with the final conclusion above stated. On page 1857 of the committee's report the following statement is made: "Operating expenses being collected from the public, it is said that the owner is reimbursed when the charge to operating expense is made. Some owners do not charge the cost of the retired item, but rather the cost of the item which replaces it—if such there be—which may be more or less than the cost of the item retired. If it is more, the public is contributing capital to this extent; if less, the owner is losing capital to this extent. This practice is prohibited by the Interstate Commerce Commission for large telephone companies, although permitted for many classes of railroad property."

Railroad ties, which are maintained under what is known as the replacement method of maintenance, are treated much like fuel. It is impracticable to keep track of each tie that is replaced and hence as these ties are wearing out fairly rapidly, the cost of replacement is charged to operating expense, and on a rising cost for ties the public is actually contributing capital to the enterprise; and on a falling cost of ties—a condition that does not exist and is not likely to exist soon to any great extent—the owner is losing capital. But this seems to be an unavoidable difficulty or departure from theoretically correct accounting.

It sometimes occurs that an item of property is not replaced at all when it wears out. Some new method of doing what this item has done has been discovered. The item has become obsolete. The cost of replacing it in kind is zero because it is not replaced. Shall the depreciation allowance be figured on this basis? Manifestly that would be absurd. The owner would have lost his investment.

Does it not seem clear therefore from the statements made, that always the depreciation allowance—when any depreciation allowance is set up in operating expense—should be based on the original cost of the depreciating items rather than on their reproduction cost as of any time or on any estimate that may be made of their future replacement cost?

Wooden Water Mains 130 Years Old

In putting in high-pressure water mains recently, workmen who dug up one of Boston's streets came across about 50 ft. of wooden water mains installed in the city in 1789 and used continually until 1840 for bringing water from Jamaica Pond in Roxbury to Boston. The pipes were installed by a corporation formed at the instance of Gov. Samuel Adams, with authority to hold $33,000 worth of real estate and to issue 100 shares of stock.

In all, 15 miles of these water mains were laid, serving a fairly large section of what is now downtown Boston and was then the whole town. At the height of its prosperity the service supplied 1,500 houses with water. The mains were replaced in 1840 with 10-in. iron pipes, and in 1849 the present municipal system, which now has more than 860 miles of mains, supplying more than 100,000 buildings, was instituted.

The wooden mains are approximately 16 in. in outside diameter, left in their natural condition on the outside, except for removal of the bark, with 4- and 2-in. bores through them. Transversely there are ¾- and ½-in. openings in which were inserted lead pipe used in conducting the water to the houses. The sections of pipe were cut off at right angles, and lead couplings were used to connect them.

The wood is said to be pitch pine. This was verified by the foreman in charge of the work, although it was first said that the mains were of cedar. The outside surface is rotted but the wood itself is still hard.

Notes from Foreign Fields

ENGINEERING CENTER OF THE BRITISH EMPIRE

BY
E. J. Mehren
EDITOR ENGINEERING NEWS-RECORD

THE "Underground," the name by which the passenger subways of London are generally known, differs radically from our subway construction in the United States in that the tubes, with the exception of those of the District Railway, are at depths varying from 50 to 70 ft. below the surface. We try to keep our rails as near the surface as possible. The American visitor naturally inquires the reason for a design that differs so radically from ours.

A brief acquaintance with London furnishes the answer. In the first place, there are few long straight streets in London, and the direct and economical routes from the business section to the residential districts must lie for their greater length under buildings and private property. Manifestly, the purchase of private rights of way in such a city as London would be prohibitive, while the driving of the tubes close to the surface would involve an amount of under pinning that would again be prohibitive.

In the second place the surface material at London is of a gravelly character, strata ranging from 40 to 60 ft. in thickness. Below is dense, compact clay free from water. By driving through the clay not only can the tubes pass under private property without disturbance of the structures above, but the construction work can go on practically in the dry, while the clay itself is ideal material through which to drive the tubes.

With the exception of the District Railway, the tunnels are built of circular cast-iron rings. The levels rise and fall in accordance with the profile of the top of the clay stratum, care being taken to keep the top of the tunnel about 10 ft. below the top of the clay, so as to exclude the water.

The District Railway was built in the sixties partly by cut-and-cover methods and partly by a double-track tunnel, with segmental arch and flattish floor, timbered during driving. The first of the tube-design lines, the City and South London, built in 1901, has an inside diameter of only 10 ft. 6 in. With these exceptions, the tubes are of a standard design, consisting of cast-iron ring, 11 ft. 8½ in. in inside diameter. Each tube railway consists of only one pair of tubes, that is, there is no express service such as we know in New York.

Plans have been made for enlarging the City and South London tube to the 11-ft. 8½-in. standard. The work is to be done during the non-traffic hours and the present cast-iron sections are to be reused, the larger diameter being secured by inserting four key pieces of somewhat greater length than the present keys. The method has already been subjected to experiment with satisfactory results.

The tubes being at so great a depth below the surface are necessarily served by elevators or escalators. As a rule elevators of large capacity are used, two or three to a station. In some of the stations escalators have already been installed and plans for additional installations have been made. They are in pairs, one running down and the other up, with a stationary stairway between. Pairs of escalators of this type have a maximum capacity of about 12,000 passengers per hour and the engineers of the Underground estimate that it would require five to six elevators to do the same work.

The tubes are generally operated with six-car trains, but changes are being made so that eight-car trains can be used. On one of the railways, the District, there are only two guards to a six-car train, the passengers—except during the rush hours—opening and shutting the doors themselves. The rear guard, after assuring himself that all the passengers who so desire have left the train or entered it, blows a whistle as a signal to start. During rush hours guards on the station platforms attend to the loading. At one time there was a guard to every pair of platforms, and the doors were mechanically operated, but this was found to be unpopular with the London public and the present scheme was adopted. However, on the tube routes there is still a guard at every pair of car platforms and the inward-swinging type of door is used. (On the District Railway sliding doors are used.) The reason for this difference in practice is that there is very slight clearance between the cars and the inside of the rings of the circular tube, so that a person getting off while the train is in transit would be crushed to death. In the District tunnels, there is plenty of space on either side, and while there might be serious consequences of alighting, immediate crushing would not result. Experiments are now under way to operate all doors in a train by one guard.

Knowing conditions in New York, one naturally asks whether the London public is satisfied to ride long distances over what must necessarily be a local-stop railroad. From what I could learn there is no dissatisfaction, none of the speed demand that we find in New York. Trains, when they get out of the heart of the business district, do skip stations and thus increase the capacity and speed of the line. It is realized, however, that as present routes become congested additional facilities must be provided and it is planned then to drive additional pairs of tubes at deeper levels and thus, while increasing capacity give an express service.

In an experience of two weeks the service in the Underground impresses one as being very satisfactory; the trains travel at high speed and with remarkable frequency. The engineers have assured me that in the District Railway they put 40 six-car trains through a given station per hour. This equals the theoretical clearance of trains in the New York subways, but I was told here that in actual practice the New York lines do not keep up to this theoretical schedule.

The fares, as I noted in a previous letter, are at the rate of a penny per mile, at which rate, though, the tubes are losing money.

London, May 18, 1920.

Omaha Takes Over Private Gasworks

The privately owned gasworks supplying Omaha, Neb., were taken over on July 1, by the Metropolitan Water District, which already owns and operates waterworks and a municipal ice plant.

LETTERS TO THE EDITOR

The Chicago Drainage Canal Decision

Sir—In your issue of June 24, p. 1274, you have a paragraph headed: "Court Restricts Flow of Lake to Chicago Drainage Canal." You say the draft of lake water into the canal is now limited by the U. S. District Court to 250,000 cu.ft. per minute. The original plan (1887) on which the Chicago drainage canal was designed and built, assumed a diversion of 600,000 cu.ft. As chief engineer of the Drainage Commission which made this recommendation after almost a year's careful observation and thorough investigations, permit me to call your attention to some engineering facts, which are not mentioned in your statement but may be of interest.

The diversion and abstraction from Lake Michigan of a large quantity of water, required for sewage dilution, and its subsequent discharge into the Desplaines, Illinois, and Mississippi Rivers, in addition to their flood flows, demanded studies in hydraulic engineering of unusual magnitude at that time. The proposed final conclusions were so definite and satisfactory that there appeared no reason against adopting the plans as recommended, which called for a long rock cut with a cross-section sufficiently large to carry 600,000 cu.ft. per minute. And the canal was built with this capacity.

The opposition of the U. S. Government to the withdrawal from Lake Michigan of that amount did not appear until later. Conversations with some of the engineer officers when the designs were being made drew out no objection. Our studies revealed no reasons for anticipating any hydraulic objection that could not be fully and readily neutralized when required. The greatest difficulty at first seemed to be the addition of this quantity of water to the flood flows of the Desplaines and Illinois rivers. When it was found that not many centuries ago Lake Michigan naturally discharged over a low divide into the Desplaines River, the accumulated alluvial soil upon the rock now being but one or two inches deep over large areas, an examination was made of the old river bed for perhaps a hundred miles down stream, which indicated that a much larger current had formerly passed down the valley; and that the erosion to be caused by the additional flow would increase the section available for flood waters, and possibly cause no increased flood heights whatever. But, if this should be the case, Chicago might be obliged to bear the expense of some shore regulation which could not be more than a small amount. It was not worth considering at all in such a large project at that time.

The other possible objection, the effects of diverting water from the Great Lakes, could be more readily subjected to an engineering investigation, and this was subsequently undertaken.

When municipal water supplies, or water for power purposes, are to be taken from small streams, it is a common practice to equalize their flow to a sufficient extent by building storage reservoirs so as to make it more uniform throughout the year than the dry-weather months on the one hand and floods on the other would permit. In the case of the Great Lakes there can be a regulation of the flow at both ends, by controlling works at the Sault Ste. Marie rapids, and by similar works in the Niagara River above the falls. The latter was by far the more complicated and expensive proposition. Its effect upon the City of Buffalo was material, and the diminution of its value to the Drainage Canal, by the fall in the St. Clair River, made such a solution insignificant for the desired conditions at Lake Michigan.

Computations at the other end resulted in the conclusion that a movable dam, not over 18 in. in height, if I remember rightly, built at Sault Ste. Marie, would add far more water to Lake Michigan, by a temporary storage of flood waters in Lake Superior, than could be dangerously abstracted by the drainage canal. When this conclusion was reached there seemed to be no physical objection to the building of the latter.

During the World's Fair in Chicago in 1893 a number of European engineers, engaged in river and harbor work and in regulating the large rivers in France, Holland, Germany and Austria, examined the drainage canal and its design. It was interesting to have their opinion on our great diversion project, because of the excellent results they had achieved in their respective countries. I heard nothing but praise of American enterprise in utilizing our vast natural advantages. One of them enthusiastically said that, if undertaken soon enough, Lake Superior alone could be developed by increased storage to furnish more wealth in water power for the United States and Canada than could all Europe, excepting only Switzerland and Scandinavia; and incidentally create large navigable waterways with ample flow of water from the Great Lakes to the Gulf of St. Lawrence and to the Gulf of Mexico with dimensions that could not be thought of in Europe.

What has our United States Government accomplished at the proper time in this direction? What are the United States courts doing to encourage such a development?

Incidentally, I would like to add that I signed the report recommending the drainage canal, primarily for sewage dilution purposes, together with Benezette Williams and Samuel G. Artingstall as consulting engineers, in January, 1887. Our designs, estimates of cost and recommendations were then based on a sufficient dilution for a term of thirty years, ended several years ago. This canal, in my opinion, could, even at its best, now no longer take proper care of all the sewage entering it, without a prior partial treatment of an annually increasing proportion of it.

Whatever objectionable conditions may have existed in the canal during intervals in the past, or possibly now exist, would be due partly to the insufficient sewage dilution allowed by the courts, partly to the admission of much private trade waste, and partly to the absence of sufficient dredging of the sludge deposited in the river, all of which is against the advice given in the original reports.

New York City. RUDOLPH HERING.

[The news note mentioned in Mr. Hering's first sentence was followed by essentially the entire decision (p. 129) and by an editorial (p. 99) in our issue of July 15.—EDITOR.]

An American Hydraulic Laboratory

Sir—In your issue of June 24 appears an article entitled "The Need for an Endowed American Hydraulic Laboratory." This is a most timely subject and I wish to encourage you in your efforts to place the matter before your readers.

Congress has just passed a water-power bill under the provisions of which the enormous power resources will, it is anticipated, be developed. Fortunately, through private endeavor, there is considerable reliable data at hand covering the use of water for the development of hydro-electric power and consequently there should not be the enormous waste of water in these proposed developments that we find in many other instances. In order to bring to the public attention the need for a more scientific use of water, reference can be made to the article appearing in the June 10 issue of your paper by E. A. Moritz, affecting the use of water in irrigation, where the following statement is found: "The quantity of water lost in transit on an irrigation project is enormous and in some cases appears to equal or even exceed, the quantity delivered to the farms."

This statement is without doubt based on facts obtained through Mr. Moritz's long experience and permits of only one conclusion to be drawn from his article; that is, under the present condition of operation it is necessary to divert twice as much water from a source of supply for any given irrigation project than is intended to deliver to the farms owing to the fact that one-half of all water so diverted would be lost in transit. The actual loss of water is not the worst feature but rather the resulting over-watering of lands, seepage of canals, ditches, etc., because of which large areas have become fairly water-logged and entire districts are now being organized for the purpose of drain-

age. As a matter of fact, when one stops to consider the entire problem of the economical use of water, so many points are immediately brought to mind that considerable surprise is occasioned that a federal hydraulic laboratory has not been in existence for some time.

We have been experimenting for a great many years with the use of water and the Reclamation Service has spent millions of dollars in various works scattered over the Western states. The engineers in charge should have had at all times the benefit of a properly equipped hydraulic laboratory and a thoroughly competent research department. It seems to me that an amendment to our recently passed water-power bill, or a rider attached to the sundry civil bill providing for our reclamation work, would be a proper manner in which to take care of the proposed hydraulic laboratory.

It would, without doubt, be well to bring this matter to the attention of irrigation institutes held in the several Western states and the attention of the Irrigation Congress, proposed to be held in Seattle next September. The parties interested in these institutes are paying a bill, a large portion of which could no doubt be eliminated if a more scientific use was being made of the various water supplies now appropriated.

Seattle, Wash. E. J. BARTELLS.

Efficient and Responsible City Government

Sir—In your editorial on "Hope for Better Government" p. 1133, June 10, 1920, you say: "A single small legislative body with legislative powers only, and a chief executive officer, chosen for competence only, and well paid, is the plan for a city that wishes to show twentieth century progress and efficiency."

How is a small, paid legislative body to adequately represent a large body of constituents, and to throw off politics, graft, partisanship and other kindred evils to which a large non-paid, two-body councils had been accustomed; and which of the two bodies can be the greater pull-back? Of course if every person elected or appointed to public office were to conscientiously abide by pre-election promises and oaths of office, we would not need to question the fact that progress and efficiency would be the result. And even if the mayor is above reproach, his hands are likely to be tied and his efforts towards progress thwarted by a division in his council. The seriousness of this division seems less likely to be a controlling factor with a large than with a small legislative body of councilmen. Will not the effect of partisanship increase in direct proportion to the decrease in the number of votes?

I have in mind our own city government in Philadelphia which, since January last, has been in the hands of just such a body as you mention, with a few question marks in parenthesis.

Our local papers frequently ask editorially, What has our council done but draw its pay regularly? To be sure, it is rather early to predict what it might do, but the taint of partisanship is there. To my mind, with a small, single body this condition can be far worse, in the last analysis, than with a large, more nearly representative body, the majority of which is less likely to be influenced in any one direction.

Therefore, I will thank you for a qualification of the above quotation from your editorial to clear away my doubts on this subject and incidentally those in other minds where they might have been raised. Please understand that I am not making criticism but seeking information, as this subject is rather foreign to my education.

Philadelphia, Pa. S. W. BARAKAT.

[The words "well paid" in our editorial note referred to the "chief executive officer" and not to the "single small legislative body" of a city. The consensus of opinion among students of municipal government is for the plan outlined in our editorial note, and is very strongly against large, two-chambered city councils—which style of council has in fact almost completely disappeared in the United States. The present-day conception of efficient city government is set forth in detail, with supporting arguments, in a considerable number of books published within the last few years and reviewed in our monthly Engineering Literature Section. Most of these books stand for the commission-manager form of city government, rather than for the mayor-and-council type, but there is general agreement on the advisability of separation of executive and legislative powers. With such a clear-cut separation of powers, separation of responsibility for action or inaction is equally clear.—Editor.]

Facts and Common Sense at the Niagara Power Plants

Sir: In your issue of July 1, 1920, p. 18, appears an article entitled "Common Sense and Engineering," consisting of paragraphs from a lecture delivered by J. E. Aldred to the students of Johns Hopkins University. In this lecture Mr. Aldred makes a comparison of the plants of The Niagara Falls Power Co. and the Hydraulic Power & Manufacturing Co. at Niagara Falls, N. Y., criticising severely the design of the former and giving high praise to the design and construction of the latter, eulogizing in particular Wallace Johnson, the engineer of the Hydraulic Co. Mr. Johnson was a friend of the writer and he is glad to read Mr. Aldred's words of praise which are a just tribute to Mr. Johnson's memory. The criticisms of the design of the Niagara Falls Power Co.'s plant are, however, based on a lack of knowledge or a suppression of the facts affecting that design and are unjust to its engineers. While we agree with Mr. Aldred as to the necessity for common sense and reason in engineering design, it is equally important that these qualities be based on facts, and this is also true of criticisms of design.

It would perhaps be unnecessary to answer Mr. Aldred's attack if it stood alone, but it has become the fashion to criticize the design of a plant which was in its day one of the monumental engineering works of the country and one which has exercised the greatest influence on the development of some of our greatest industries.

The plans for the N. F. P. Co.'s development—which fixed for all time its fundamental features—were passed upon by an international commission consisting of Lord Kelvin, Prof. Unwin, Dr. Coleman Sellers, Col. Turrettini and Prof. Mascart. It would seem impossible that these gentlemen should have attained the position of leaders in engineering in their respective countries without being endowed with and exercising both common sense and reason. The standing of these engineers cannot be adversely affected by criticism by Aldred or anyone else, but as some of them have passed away it seems proper that some one familiar with the facts should rise in their defense, lest the criticisms of the unthinking or ignorant should give the younger generation of engineers the impression that an engineering blunder of magnitude had been made in the design referred to.

The fundamental features of the design of the plant of The Niagara Falls Power Co.'s plant and that of the Hydraulic Co. are the short entrance canal and long discharge tunnel of the former plant and long canal and very short discharge race of the latter. No hydraulic engineer will question the superiority in most cases of the latter design, both from the engineering and commercial standpoints, but in the plant in question the following facts, among others, should be considered:

(1) The canal of the Hydraulic Co. was commenced and the right-of-way acquired through what is now the heart of the business section of the City of Niagara Falls, about 1860. The first work on the plant of the Niagara Falls Power Co. was started in 1890. The acquisition of a right-of-way for a second canal from the upper to the lower river at the latter date would have been very costly and probably would not have been permitted by the city authorities. In any case the canal would have been of great length and have involved an immense initial outlay which would have made it impossible for the later plant to compete with the earlier and less expensive plant.

(2) The State Park was established at Niagara Falls subsequent to the building of the Hydraulic Co.'s canal and the erection of numerous mills operated by hydraulic power

under low heads by means of water taken from the canal. These mills and their surroundings were considered an eyesore in the vicinity of the falls and the Park Commission would not have consented to a duplicate of such a plant. The engineers of the N. F. P. Co., were therefore faced with the problem of developing power in such a manner as to preserve the scenic beauty of the falls and their surroundings. The financiers of the company were in full accord with the views of those who sought to protect the natural scenery. They wished to build a plant which would not only be a commercial success but which would add to the beauty of one of nature's wonder spots and not detract therefrom. It is difficult if not impossible to conceive—even after the advances in engineering science during the past 30 years—how any engineers having a full complement of common sense and reason could have solved the problem by any method other than that adopted.

(3) It was necessary to provide factory sites near the power house and the acquisition of such sites along the lower river at the top of the lower river bank would have been expensive if not impossible. This factor of near-by factory sites would not enter into the problem today, but in 1889 and 1890 it was paramount and farm lands were available at a moderate price along the upper river. The importance of having sites near the power house will be appreciated when attention is called to the conditions of transmission at that day. Plans were received by the International Commission for transmission of power by rope, by water under pressure, by compressed air, and by electricity, but none of these was satisfactory for more than a few miles and the efficiency was low even for such distances. In 1890 the late Mr. George Westinghouse advised a prominent man interested in the company that power could not be transmitted by electricity from Niagara Falls to Buffalo. This difficulty of transmission made it still more necessary to locate the power house along the upper river so that if all methods proved a failure factories might be located along the line of the canal and develop their power hydraulically. The earlier plans shown such an arrangement and the location of the present canal was fixed by this consideration. While Mr. Aldred does not criticise the fact that more land was purchased for factory sites than would be sufficient today for the consumption of all of the power from the canal, this action doubtless has its critics who also do not know the facts, but the power company's engineers must again be exonerated from blame when the conditions are known. In 1890 electro-chemistry was in its infancy, electro-metallurgy was not a commercial possibility. It was anticipated that all the power produced would be used by textile or other factories using a maximum of 1000 hp. and employing about one person per hp. A large acreage would therefore have been necessary for factories and home sites.

(4) Mr. Aldred says "Everything about this enterprise indicated a disregard of economy." Those who were connected with the plant know this criticism to be unfounded and that it is based on a superficial inspection. It is freely admitted that the cost per hp. was greater than that in the plant of the Hydraulic Co. whose chief asset in land is said to have been bought for $60,000 but Mr. Aldred has used the word "enterprise" in a happy manner as applied to the plant of the N. F. P. Co. It required enterprise, vision and faith both on the part of its financiers and its engineers. Its design constantly dealt with problems in the untried. The plant was a pioneer. Careful search fails to disclose a turbine operating under more than 100 ft. head prior to 1890 or having more than 2500 hp. capacity. Yet the first turbines installed in this plant were of 5000 hp. capacity and operated under 136 ft. head; there were no data for friction coefficients in the tunnel; the conditions as to electrical transmission were those above described; it was considered impossible to switch 2200 volt current. These are only a few of the problems and we all know that it costs more to blaze the trail.

In regard to Mr. Aldred's criticism of extravagance on the part of the engineers who were connected with the construction of the plant as shown by a flagstaff (which, by the way is wood and not bronze) and by ornamental details on power house and office building, our critic from his experience as a business man must be aware that engineers do not erect flagstaffs and ornamental buildings unless these forms of construction are desired by the men who are furnishing the money. A good engineer will insist on safe and stable construction but not on ornaments. The latter depend on the owners. So why direct all the criticisms at the engineers? The men who had faith in the future sufficient to invest their own millions—not the public's—in this plant are too eminent to need an advocate but the writer believes that he is correct in stating that they desired it to be an ornament to the city. There are still men who look beyond the dollar. Why Mr. Aldred should think that substantial or even ornamental construction should indicate "An expensive upkeep" is hard to understand. The books of the company show the contrary.

The plant of the Niagara Falls Power Co., is not one of the substantial failures to which Mr. Aldred refers elsewhere in his lecture. It always paid its bond interest; for many years before its recent sale it paid 8 per cent on its common stock in addition to amassing a surplus of several millions. It will hardly do to say that it did this in spite of its engineers.

There is no question that the ideal plant is yet to be built at Niagara, the one in which the water will give its maximum duty, but the national government and not engineers has prevented the use of water in the way that common sense and reason would dictate in this day, but destructive criticism is easy and it is well for a critic of a plant designed in the early 90's to know facts.

Later in his lecture Mr. Aldred states "Personally I have seen hundreds of reports on water-power projects but I have never yet seen an unfavorable report"; then, after blaming engineers for a loss sustained in an unfortunate power development he continues, "Engineers always want to do a job of work. They never turn down a job." The first statement must be accepted as fact even though Mr. Aldred's experience probably stands alone but the last general statement should not pass unchallenged as it is an adroit way of stating that engineers are dishonest and will always report favorably on a project so that they may construct the work. This is unfair to the members of a profession whose ethics are certainly as high as those of the business man and promoter even though in rare cases an engineer at the solicitation of a stock jobber may make his report too favorable. It is unfortunate that the students at Johns Hopkins should receive from their lecturer such an unfavorable impression of engineering ethics.

Buffalo, N. Y. A. H. VAN CLEVE,
Civil Engineer.

Where Is Our Road Program Taking Us?

Sir—As a constant reader for more than thirty years of your good, comprehensive publication, I noted the excellent article by J. N. Mackall, chief engineer, Maryland Roads Commission, entitled, "Where Is Our Road Program Taking Us?" in your issue of May 6, p. 914. He states the fact concisely by saying that there is no kind of "permanent" road or pavement; also that maintenance includes repairs, resurfacing and rebuilding when that becomes necessary. Maintenance should always be paid for from current income, such as annual taxes, automobile and other licenses for use of highways, and never from bond issues or general funds, which, if done, would "eventually bankrupt the government" of nation, state, county or town.

The writer, from thirty years study and practice of road and pavement construction and maintenance, differs with Mr. Mackall where he seems to imply that it is economical to construct portland cement concrete roads with a view to use them eventually as foundations for bituminous surface layers. His statement is: "When it (meaning a portland cement concrete or any road or pavement without a wearing surface layer capable of consistent maintenance) reaches a point where it can no longer be economically maintained as a concrete road it can be resurfaced with some form of good, hot-mixed bituminous pavement to give another period of long life, conserving the entire initial investment."

The fact is only a portion of the initial investment is

conserved or salvaged, because much of that investment has gone by reason of abrasion, disintegration or "fatigue," as Mr. Mackall calls it, and cracking of the concrete from wear of traffic and effects of weather.

The first cost of a cement concrete road or pavement, adequate to support traffic for a reasonable period of years, is greater than the first cost of a foundation of cement concrete or good foundation of other material, together with a substantial wearing surface layer of some form of good, dense, hot-mixed bituminous pavement or other standard material. Such surface layers distribute the impact and pressure of traffic and protect the foundation from injury from traffic and weather. The subsequent maintenance of this standard construction, including resurfacings at long intervals of years, can be economically done, and it is possible always to have a good, solid foundation on which to keep this maintained layer. Such a surface layer is more lasting on a foundation made for it than where placed on an old, worn out and cracked cement concrete road or pavement.

The value of an old concrete road, which can no longer be properly repaired by filling cracks and holes with bituminous compounds, etc., is much less than the initial investment. Many such old concrete roads and pavements which the writer has had to use, when necessary, for foundations for wearing surface layers of other materials have had an appraised value of less than half of the cost of the original cement concrete roads or pavements. It is a fallacy to argue that cement concrete roads should be constructed because, when beyond repair, they will have a high salvage value for foundations for future roads of any kind.

Relatively new concrete roads appear to a layman and to engineers not familiar with road and pavement records to be "permanent" and they rely on "durability" of a new pavement as the only factor of economy; whereas the experienced engineer knows that repairs to all roads and pavements must begin soon after construction and be constantly kept up.

The problems of how to construct a portland cement road so that constant eventual maintenance will be economically possible and how to maintain such a road in constant, smooth, viable and handsome condition are problems not yet solved. They are worthy of careful study. These problems have long been solved for many other kinds of roads and pavements by constructing practically everlasting foundations, laying on them substantial wearing surface layers of suitable materials and thicknesses, then maintaining those surface layers by "a stitch in time saves nine" and resurfacing with the same materials at very long intervals of years. There are hundreds of such examples in all the important cities and countries of the world, among them Pennsylvania Ave., from the Capitol to the Treasury, Washington, D. C., laid in 1877; Fifth Ave., from Eighth to Forty-second Sts., New York City, laid in 1898; Bergere St., Paris, France, where a wearing surface layer of bituminous limestone was laid on a durable foundation, and that reparable surface layer kept in good condition ever since.

J. W. HOWARD,
Consulting Engineer.

New York City.

Shall Engineering Societies Admit the Sales Engineer?

Sir—A well known dictionary defines engineering as follows: "The art and science by which the mechanical properties of matter are utilized in structures and engines."

To be an engineer, then, one must primarily deal with the mechanical properties of matter as applied to structures or engines. Many men, of course, devote their entire lives to the abstract study of mechanics, but there are others who do not and are properly considered engineers worthy of the highest recognition by engineering societies. In fact, there is a premium placed upon the ability to conceive a problem as a whole rather than its intricate calculations. Some of the world's most noted engineers were not students of mechanics.

Ferdinand de Lesseps was an engineer; he saw the economic possibilities of the Suez Canal. He was the engineer who so ably determined that the channel should be maintained at sea level. Yet, it cannot be said that his greatness was due to his intimate knowledge of the mechanics of materials with which he worked. His success, it might be suggested, was in no small measure because of his ability to make other people believe in him—that is, selling his ideas. So, also, a consulting engineer sells his ideas, many of which do not involve mechanics.

Another man recognized by technical societies, but not a true engineer in the narrow definition of the word, is the contracting engineer. His work usually involves the selling of his services and then the organization of his forces. While selling his services he frequently requires the help of a man not connected with his organization nor recognized as an engineer—the sales engineer. Let us review a typical example:

Take the case of the bidder on a contract for the movement of a large quantity of earth, with a considerable bonus offered for time saving. Keen competition makes the contractor marshal all of his engineering knowledge and that of his co-workers. Before he gets very deep into his problem, however, he realizes that he needs the help of an engineer well versed in the application of machinery. For this specialized help the contractor rightly applies to the machinery manufacturer, who offers the service of his sales engineer. This particular and specialized engineer has been developed in recent years to satisfy a real need.

The last decade has seen rapid improvement in material-handling machinery and in the application of machinery to construction work. Indeed, it has been so rapid that the contracting engineer and the consulting engineer have not attempted to keep fully informed upon all methods and all machines. They rely upon the manufacturer to furnish expert help when needed.

The work of the sales engineer begins when the contractor first opens the advertisement and concludes only when the success of the undertaking is assured. In fact, the engineer practically becomes part of the contractor's organization—assisting and advising on the estimates of cost, planning plant layout, supervising the erection of the plant and directing its early operation. The usefulness of the sales engineer is not ended, however, when the actual construction is in progress, as he is called upon to remedy any subsequent troubles that might hinder the efficiency.

No one doubts that certain experience and engineering ability are necessary to render such service. More than experience and ability, however, are required as an entrée to the engineering societies; they request that the applicant be charged with certain financial responsibilities. It is true that the sales engineer is not financially responsible for the success of the contractor's undertaking, nevertheless, he is morally responsible in so far as success is dependent upon machinery. If the engineering were not sound, if the recommendations were not profitable to the contractor, the position of sales engineer could not exist.

The justly conservative engineering societies have had time to investigate the desirability of admitting sales engineers and it is proper that they should voice their opinions. They can give no more fitting recognition, however, than to invite into their midst sales engineers who have contributed to the success of their members.

NICHOLAS GERTEN,
Allied Machinery Co. of America.

New York City.

[An entirely different opinion on the general subject discussed by Mr. Gerten was expressed in a recent paper by John W. Cunningham, consulting engineer, of Portland, Oregon; see article entitled "Free Engineering Advice," *Engineering News-Record*, July 1, p. 21.—Editor.]

Rochester Water-Works Shop Always Open

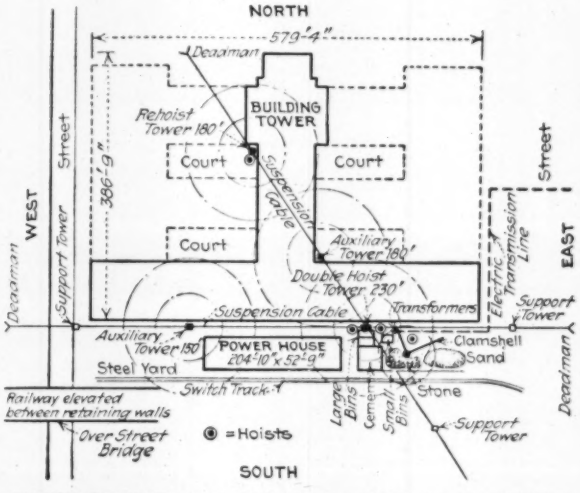
The key to the water-works repair shop of the City of Rochester was thrown away forty years ago, said Beekman C. Little, superintendent, in a paper at the recent Montreal meeting of the American Water-Works Association. The shop is always open, with some one on duty.

HINTS FOR THE CONTRACTOR

Concrete Building Plant Plan—III

Large Area T-Shaped Factory Spouted From Five Towers

EXCEPTIONALLY heavy tower and suspension cable equipment characterizes the chute distribution plant for the Bunte factory being constructed in Chicago. With a double hoist tower 230 ft. high chuting two ways to auxiliary towers 150 ft. and 180 ft. high and a rehoist tower 180 ft. high, two lines of 1¼-in. suspension cables, with spans of about 1,000 and 1,200 ft., were required. In a measure, this equipment was planned for a more extensive operation, as is indicated by the plan. The structure shown by the dotted lines, as well as the T-shaped building and the power house, was contemplated when the plant arrangement was determined. This additional construction would have



TOWER LAYOUT FOR TWO-WAY CHUTE DISTRIBUTION

increased the volume of concrete to 50,000 cu.yd., or to about double the yardage of the present operation.

Railway tracks elevated between retaining walls, with a street bridge just west of the building, determined the take-off of the permanent factory switch from the east and also, incidentally, the corresponding location of the construction switch. With a stub street on the east having only light traffic the logical location of the unloading and mixing plant was next to the railway switch and east of the power house. Located in the angle between the main building and the east end of the power house, a double hoist tower, spouting direct and chuting two ways to three other towers, enabled about three-quarters of the area of the two buildings to be reached with 100-ft. radial spouts, and allowed all of the towers to be located clear of the structure. The rehoist tower, as located, also permitted spouting to all floors of the nine-story building tower rising five stories above the main structure.

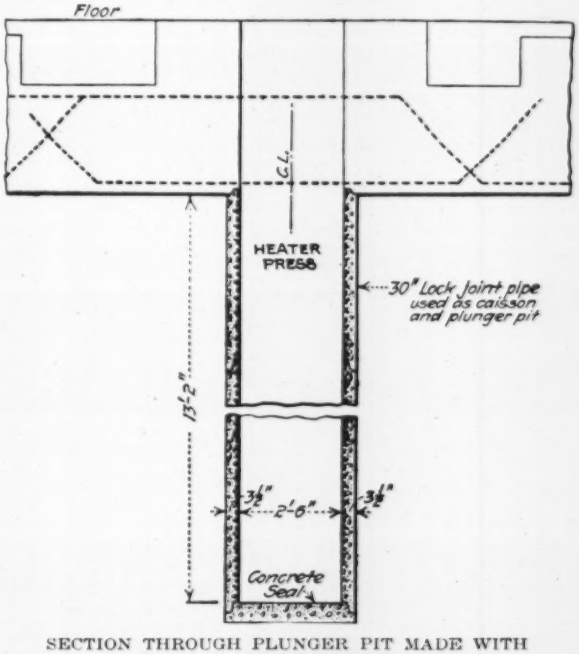
Arriving by rail the sand and stone are unloaded by a 1 cu.yd. clamshell into stock piles and bins and the cement by hand into a 3,000 bbl. shed. Sand and stone are lifted by the clamshell into the small bins holding 90 cu.yd. of stone and 60 cu.yd of sand. These bins are primarily hoppers, within convenient derrick reach, for feeding a horizontal conveyor and a bucket elevator which delivers to the 480-cu.yd. stone compartment and the 220-cu.yd. sand compartment of the large bin. A 5 hp. motor operates the chain conveyor and the elevator motor is 20 hp. The mixers are two 1 cu.yd. machines. For unloading and mixing, the organization consists of one operator and two laborers unloading sand and stone; one operator and two laborers on the conveyor and elevator; four men unloading cement and carrying it to the mixer, and a mixer crew of two operators, one man feeding sand and stone and two men charging the cement.

For the double tower a 90-hp. and a 60-hp. electric hoist are operated by a crew of one operator, one man at the bottom and two men on the tower. When they are in use there is a man on each auxiliary tower. Inability to obtain power service necessitated a 9 x 10-in. steam hoist for the rehoist tower. One operator and one towerman is the required crew. Distribution on the floor requires eight wheelers, three men grading concrete and a man at the hopper.

The plant was installed by R. C. Wieboldt, general contractor, Chicago, Ill.

Recast Concrete Pipe for Plunger Pits

IN A RECENTLY completed factory building there were required for some presses 64 plunger pits, each 2 ft. 6 in. inside diameter and 13 ft. deep. For the outer casing of the pits vertically placed precast concrete pipe were sunk in the earth and a steel casing,



SECTION THROUGH PLUNGER PIT MADE WITH SECTIONAL CAST CONCRETE PIPE

containing the press plunger, afterwards put in. In executing the work a hole was excavated approximately 2 in. smaller in diameter than the pipe and carried down a distance of approximately 13 ft. Two or three lengths of pipe were then set up in a verticle position over this hole, and guided by a template, were allowed to settle under their own weight as far as they would go. A head block was then put over the top pipe and by means of a steam hammer the pipe driven to the bottom of the excavation. The excess material which the lower edges of the pipe cut away on its descent was then removed from inside the shaft and the bottom of the hole was concreted in.

The work was done by Stone & Webster, of Boston, Mass., using pipe made by the Lock Joint Pipe Co., Ampere, N. J.

Tamping Holes in Quarry Work

COMMENTING upon a recent fatal accident caused by the use of a heavy plunger and employment of hard tamping in charging a line of holes for quarry excavation, a recent bulletin issued by the Bureau of Mines, Department of Interior, asserts that for all purposes a wooden tamping bar should be used. And even with a wooden tamping bar the tamping should not be continued beyond the minimum time necessary. If it is found necessary to use a lead puncher, as was the case in the aforementioned accident, it should be provided with a copper rather than an iron eye. Subjecting of any explosive to frequent impact with any heavy weight is dangerous practice, says the bulletin.

Hospital Service Costs Contractor Seventy-Five Cents a Case

ABOUT $1,100 built and equipped the field hospital illustrated, which gave first aid to a force of 700 men constructing a large industrial plant at Buffalo, N. Y. The work involved the usual construction of brick, steel and concrete, with track work and considerable carpenter work on forms. There were no serious accidents and the treatment given was generally of the nature of caring for hand and foot injuries. About 43 employees a month were treated and the cost per case, where only first aid was rendered and the period of disability did not involve any lost time, w about 75c.

As illustrated, the hospital building is 10 x 20 with a beaver board partition dividing it into halv

EMERGENCY FIELD HOSPITAL, 10 x 20 FT., WHICH COST $482

FIELD HOSPITAL EQUIPMENT, COST $600

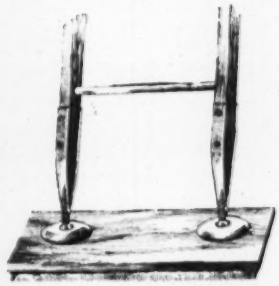
The cost of construction was $232 for labor, $17 for lighting and $233 for materials. The equipment cost $600. In the entrance room there was a supply case containing the necessary bandages and such simple instruments as a field nurse can deftly handle. This room also contained a waste jar and an electric sterilizer and hot water heater, a chair and a telephone. In the rear room in the corners behind the partition were two cots, and a chair and a curtain. A trained nurse in constant charge was paid $30 a week for her services.

The hospital was installed by the contractors, The Austin Co., Cleveland, O., and this description has been prepared from information furnished by F. J. C. Dresser, district manager.

Non-Slip Mats Give Ladder Safety

LADDERS equipped with safety non-slip mats, as illustrated below, are being used extensively in the works of the Eastman Kodak Co., Rochester, N. Y., a member of the National Safety Council.

W. T. Barrett of the Eastman Co., who designed the appliance, writes that it is giving complete satisfaction. The mat is attached to the ladder by means of ball and socket joints which permit the ladder to stand at any angle while the mat rests flat on the floor.—*National Safety News.*



SIMPLE DEVICE REDUCES LADDER ACCIDENTS

Blasting Out Broken Post Stumps

A quick and easy way to extract a broken post stump is to drive a hole close to the stump and to a few inches below its bottom with a pointed steel bar and charge this hole with half a stick of dynamite. The blast removes the stump and also excavates the hole for a new post.

NEWS OF THE WEEK

New York, July 22, 1920

Subway Contract Relet at Large Increase in Cost

Award of a contract to complete part of the 14th St. subway line in New York City to Patrick McGovern has been approved by the Board of Estimate, New York City, the contract price being $3,364,000. The work involved in completion of the contract section originally let to the Degnon Contracting Co. for $1,972,349, and abandoned by the contractor in July, 1919, when about 35 per cent of the work had been completed. Some months prior to that the contractor offered to complete the contract for the sum of $626,000 over and above the original contract price. The amount to complete the section under this offer would have been approximately $1,800,000. The offer was approved by Transit Construction Commissioner John H. Delaney and its approval recommended to the Board of Estimate by him, but the Board of Estimate rejected the recommendation and ordered the uncompleted section relet. Under the new contract the work is to be completed in fifteen months.

Missouri River Highway Bridge To Be Built

A bridge having three 470-ft. riveted truss spans, with concrete roadway and sidewalks, is to be built across the Missouri River at Bismarck, No. Dak., to carry the state highway between that city and Mandan. The trusses will be spaced 30 ft. center to center and bitulithic concrete will be used for the roadway. For the approaches there will be 1,100 ft. of reinforced concrete viaduct. C. A. P. Turner, of Minneapolis, is designing and supervising engineer for the state and the counties, and the work will be under the direction of W. H. Robinson, chief engineer of the state highway commission. Contracts have been let to the Foundation Co. for the substructure and to the American Bridge Co. for the steel work of the superstructure. The total cost is said to be nearly $1,000,000.

Bay State Highway Engineers Get Pay Increase

As a result of the efforts of the Boston chapter of the American Association of Engineers, the employees of the state highway division of the Massachusetts Department of Public Works have been granted an increase in salary averaging 20 per cent and effective June 1, 1920. Other engineering departments were given an increase which is reported to average about 12 per cent.

General Marshall Becomes Manager of Associated Contractors

Brigadier-General R. C. Marshall, Jr., former chief of the Construction Division of the United States Army, was appointed July 1 to the newly created position of general manager of the Associated General Contractors, following his resignation from the service. The Construction Division, as has been noted in these columns re-

BRIG.-GEN. R. C. MARSHALL, JR.

cently, has become a part of the Quartermaster Corps and the rank of brigadier-general applying to the chief of the division therefore ceases.

The new office which General Marshall has taken is the result of a great enlargement of the functions of the Associated General Contractors. It is announced that his selection marks the beginning of an active campaign to carry through the program which has been developing during the past year of preliminary work. Besides the direction of the work of sixteen committees, this program includes the development of the publication and information service, the contractors' service corporation, the legislative service and other service bureaus of the association and the several members' divisions, including the building contractors' division, the public works contractors' division, the highway contractors' division and the railroad contractors' division, many of which have been organized in charge of different members of the staff during the past year.

General Marshall graduated from the Virginia Military Institute just before the Spanish War and became a

(*Continued on p. 189*)

Joint Committee Discusses Federation Problems

Bulletin Just Issued Explains Details Relating to Representation and Finances of New Organization

In the second of its bulletins dealing with matters concerning the organization of the Federated American Engineering Societies the Joint Conference Committee, representing the four founder societies, discusses questions of representation and finance. Extracts from the bulletin follow:

BASIS OF REPRESENTATION

"There seems to be difficulty in understanding what the basis of representation should be where a state organization exists and where there are also strong local organizations and affiliations. The constitution provides that a state council or organization, representative of the engineers and allied technologists in the state, can be represented on the American Engineering Council on the basis of all the engineers and allied technologists in the state. If, however, there exists a strong local organization or affiliation which elects to have its own representative or representatives on the Council then the state council or organization is entitled to representation on the basis of all the engineers and allied technologists in the state, less the engineers and technologists that are to be represented through their local organization or affiliation. This will not prevent the local organization or affiliation from participating in the work of the state council or organization in the consideration of matters affecting the state only.

MEMBER SOCIETIES TO SUPPLY FUNDS

The Joint Conference Committee has received several letters inquiring as to the provisions for dues. The constitution and by-laws (see *Engineering News-Record*, June 10, p. 1139) provide for funds contributed by the member-societies for the support of The Federated American Engineering Societies. Inasmuch as it would be unreasonable for a small local society to pay as large a contribution as a national society the constitution provides that the contribution shall be on the basis of the number of members in the organization at the rate of $1.50 per member for national societies and $1 per member for local, state and regional organizations or affiliations. The individual, therefore, does not directly pay any dues but the member-society of which he is a member contributes to the support of the Federated American Engineering Societies on a per capita basis

of its membership. It therefore follows that any one who is a member of several organizations which hold membership in The Federated American Engineering Societies will be counted in the total membership of each society as a basis of its contribution.

"As to the statement that the organization is expensive, it is pointed out that on the basis of the present membership of Engineering Council the income from the contributions provided in the constitution of The Federated American Engineering Societies would be about $75,000. At no time in the history of its existence has the budget of Engineering Council exceeded $50,000. Provision is made, however, that 'The Executive Board shall, whenever practicable, provide for the whole or a part of the expense of members or of representatives attending its own meetings and those of the Council.'

"On the basis of past experience, it is estimated that if the expense of all the representatives on American Engineering Council and of the members of its Executive Board were paid to each meeting of these bodies, there would be involved an annual expense of about $25,000. The purpose of these expenditures was to secure a full attendance of the representatives of The American Engineering Council and on the Executive Board, especially during the earlier years of the organization. As will be noted in the excerpt from the constitution, the expenses of representatives of the Council and members of the Executive Board will be provided from such funds as may be available. If, in the judgment of the Executive Board, this money should be required for more urgent work, the expenses of the representatives and members would not be provided for. It seems to the Joint Conference Committee that it would be highly desirable to have sufficient funds to pay the expenses of this representative body of men who contribute their time for the good of the engineering and allied technical professions. The payment of these expenses is the only part of the organization that can be said to be expensive.

ORGANIZATION DEMOCRATIC NOT AUTOCRATIC

"It has also been stated that the form of organization that has been set up is 'autocratic, not democratic.'

"If a democratic organization is taken to mean one in which its constituents have a voice in its affairs then the Federated American Engineering Societies is truly a democratic organization. Member-societies of this organization are represented on the American Engineering Council which has full power to control and to direct the activities of the American Engineering Council and of its Executive Board and can determine whether it is necessary for the former to meet annually, biannually, or tri-annually, or how frequently the latter shall meet.

"The Joint Conference Committee is unqualifiedly of the opinion that an opportunity has been created for bringing about a solidarity of the engineering and allied technical professions that has never heretofore been available and that the success of the movement will depend on the whole-hearted support of each American engineer and of each technologist, who, if determined that this movement shall succeed, will obviously not bother with the details of the form of organization, in his effort to secure the end desired."

W. G. Thompson Joins Lakewood Organization

W. G. Thompson, formerly state highway engineer of New Jersey, has become associated with the Lakewood Engineering Co. of Cleveland. Although his new connection, effective July 16, will be in a general engineering capacity, Mr. Thompson will for the present give specific attention to the handling of construction work and industrial equipment, with headquarters at the company's New York office.

Since 1904, when he was an inspector of dredging and breakwater work on Long Island Sound, Mr. Thompson has been engaged on a variety of engineering projects. From 1905 to 1910 on the Panama Canal his duties included general survey and construction work, including topographic and railroad surveys and railroad and shop building construction. The following year he was draftsman in the chief engineer's office of the Oregon & Washington R.R., at Seattle, engaged principally on passenger terminal and freight classification yard layout, and from 1911 to 1916 he was supervisor and superintendent of construction on the locks and terminal facilities of the Panama Canal, his work including the construction of reinforced-concrete wharves, foundations and shop buildings, as well as general construction of terminal facilities. During this period he was in full charge of the construction of the Cristobal coaling plant at the Atlantic entrance to the Canal. Subsequently, for a short period he was superintendent of the Raymond Concrete Pile Co., New York, on the construction of the Sun shipyard at Chester, Pa., and the Bethlehem steel plant at Steelton, Pa. In April, 1917, Mr. Thompson was appointed assistant state highway engineer of New Jersey, and a year later became state highway engineer.

Everglades Drainage Act Upheld

The constitutionality of the act enlarging the Everglades Drainage District (Chap. 7862, Fla. Laws, 1919) has been upheld in a decision by the Supreme Court of Florida, in a suit brought by Robert L. Bonnerman. The act authorized a bond issue of $2,500,000. The Commissioners of the Everglades Drainage District were represented by Glenn Terrell, Tallahassee, Florida.

Lt.-Col. Whiteside Temporary Head of Construction Service

Lt.-Col. Warren W. Whiteside has been designated as the temporary head of the construction service in its new status as a subdivision of the Quartermaster Corps, U. S. Army. No changes have been made in the heads of the various divisions of the construction service. The work will be carried on in exactly the same manner as was the case when it was a separate division of the War Department. The permanent chief of the construction service, it is understood, will be selected within the next few weeks.

Construction Division Becomes Part of Quartermaster Corps

Effective July 15, the Construction Division of the Army became one of the subdivisions of the Quartermaster Corps. The text of the formal order reads as follows:

The Secretary of War directs that pursuant to the act of Congress approved June 4, 1920, amending the act entitled "An Act for making further and more effectual provisions for the national defense, and for other purposes," approved June 3, 1916, the Transportation Service, the Motor Transport Corps, the Construction Division and the Real Estate Service, and the records and enlisted and civilian personnel pertaining thereto, are transferred to the Quartermaster Corps, effective July 15, 1920. The commissioned personnel pertaining thereto are detailed temporarily for duty with the Quartermaster Corps, effective the same date. Thereafter these services will operate under the direction of the Quartermaster General.

The Construction Service shall be organized and operated as a separate service of the Quartermaster Corps and shall be charged with the construction, maintenance and repair of buildings, structures and utilities of the Army other than fortifications and with the operation of utilities. The Construction Service shall also be charged with the acquisition of all real estate and the issue of licenses in connection with Government reservations after authority for such acquisition or license has been obtained in each case from the Secretary of War.

The Construction Service, Quartermaster Corps, shall be charged with the consummation of the sales of those surplus Government properties heretofore assigned to the Construction Division and the Real Estate Service for disposition. Real estate, plants, facilities, etc., belonging to the War Department and hereafter declared surplus and ordered disposed of will be disposed of by an agency to be designated by the Secretary of War in each case.

Brig.-Gen. R. C. Marshall, who has been head of the Construction Division, has retired from the service, as noted elsewhere in this issue.

To Report on More Water for Philadelphia

For the purpose of studying the water-supply requirements of Philadelphia for the next fifty years, Mayor Moore has appointed the following commission: J. Waldo Smith, chief engineer New York Board of Water Supply; George W. Fuller, consulting engineer, New York City; J. W. Ledoux, consulting engineer, Philadelphia; and Joseph F. Hasskarl, formerly director of Wharves, Docks and Ferries, Philadelphia. A preliminary report is expected by Sept. 15.

Program for Am. Soc. C. E. Meeting Announced

The local committee on arrangements for the fiftieth annual convention of the American Society of Civil Engineers to be held at the Multnomah Hotel, Portland, Ore., Aug. 10-12, has tentatively adopted the following program:

Aug. 9—Meeting of the Board of Direction; short automobile trips.

Aug. 10—Addresses, followed by business session, during morning and afternoon; dancing in the evening.

Aug. 11—Trip up the Columbia River to Eagle Creek, about 45 miles. One-half of the party will go by boat and return by automobiles, and the other half will go up by automobiles and return by boat. At a smoker in the evening, to which ladies are invited, Frank Branch Riley will give an illustrated talk on the scenery of the Northwest.

Aug. 12—This day will be devoted to the individual tastes of the members and their guests. Transportation and other facilities will be provided for those wishing to play golf, an inspection trip about the harbor has been arranged, and trips to the wood-pulp paper mills at Oregon City and to the hydroelectric plant of the P. R. L. & P. Co. at Cazadero will be made.

By invitation of the Seattle Section, the Spokane Section and J. L. Lytel, project manager of the U. S. Reclamation Service at Yakima, members and their guests are asked to include Seattle, Yakima and Spokane on their return trip, leaving Portland Aug. 12 at 11 p.m. on the Northern Pacific Ry.

The Calgary Branch of the Engineering Institute of Canada has extended an invitation to Am. Soc. C. E. members and their guests to attend a western professional meeting at Banff, Aug. 14-18 inclusive. The meeting will be held in true western style under canvas.

Complete Appointment of Grand Trunk Arbitration Board

With the appointment on July 12 of Hon. William Howard Taft to the Grand Trunk Arbitration Board, the membership of this board is now complete, including Sir Walter Cassells, chief justice of the Exchequer Court, as chairman; Sir Thomas White, ex-Finance Minister of Canada, representing the government; and ex-President Taft, representing the Grand Trunk Railroad.

The board will begin its sittings in September for the purpose of determining the value of the first, second and third preferred stock, and the common stock of the railway company, which have a total par value of £37,073,491. The award is to be made by the arbitrators within nine months of the time of their appointment unless the time is extended by the government. In case the award is not unanimous an appeal can be taken to the Supreme Court of Canada or to the Judicial Committee of the British Privy Council.

Colonel Taylor Named Assistant to Chief of Engineers

Col. Harry Taylor, Corps of Engineers, U. S. Army, has been appointed to the newly-created position of assistant to the Chief of Engineers, with rank of brigadier-general. General Taylor was the first chief engineer of the American Expeditionary Forces, accompanying General Pershing to France in May, 1917.

He was born in Tilton, N. H., June 26, 1862, where he attended the public schools. He entered West Point in

BRIG.-GEN. HARRY TAYLOR

1880 and was graduated four years thereafter. His first important work was done on the Pacific coast, where he was stationed for nine years. He was engaged on construction for practically all the fortifications on Puget Sound and was in charge of the Seattle river and harbor district for a time. He served three years as district engineer in Boston, was two years at Philadelphia and five years at New London. Under his supervision the lock gates at the Cascades on the Columbia River were completed in 1896. In 1911 he was called to Washington as assistant to the Chief of Engineers in charge of the river and harbor section of the office. Except for a short time, while in charge of the first New York district, he continued directing the river and harbor work until the outbreak of the war.

In May, 1917, he went to France with General Pershing as chief engineer officer of the A. E. F., later being promoted to brigadier-general. In September, 1918, he was returned to Washington at the request of the Chief of Engineers to resume charge of the river and harbor work. During his period of service in France, a consolidation of various departments was effected which resulted in Major-General William C. Langfitt being made chief engineer, A. E. F. General Taylor continued in charge of the Division of Military Engineering and Engineer Supplies until his return to the United States.

General Taylor is regarded as an authority in fortification construction and is given credit for an important part in the development of the Army searchlight. It was under his direction that the hoist for raising projectiles from magazines to gun platforms, now the army standard, was developed.

General Taylor will continue in charge of the river and harbor work of the Corps of Engineers.

St. Louis To Build Concrete Sewer by Day-Labor Plan

On July 29 the City of St. Louis received bids for the construction of 4,500 ft. of 12-ft. and 3,400 ft. of 6- to 8-ft. reinforced-concrete sewer, to be known as the South Harlem public sewer. The appropriation for this work was $350,000. The lowest bid was that of the Moreno-Burkham Construction Co., amounting to $382,000. After a thorough analysis of the situation it was found that the bid was exceptionally well balanced and entirely reasonable in consideration of the increased cost since the date of the original appropriation. However, because sufficient money was not available it was impossible to award the contract, and after some deliberation it was decided to carry out the work with the city's forces. To this purpose, a special section is being organized under the Division of Sewers and Paving. W. W. Burden will be engineer in charge of construction under W. W. Horner, chief engineer, sewers and paving. E. R. Kinsey is president of the Board of Public Service.

Brig.-Gen. R. C. Marshall, Jr.

(*Continued from p. 187*)

captain of volunteers in that war. After the war he taught for a while at the Virginia Military Institute, but in 1902 joined the United States Army with the rank of second lieutenant. He was a captain in the Quartermaster Corps when the World War broke out, having been for a number of years connected with the construction work of the army. In 1917 he became General Littell's assistant in the then Cantonment Division and was rapidly promoted to rank of colonel. On General Littell's retirement, early in 1918, he was made officer in charge of construction of the division with the rank of brigadier-general. His services in this connection are well known to the engineers and contractors of this country. The direction of the Construction Division was one of the successful features of our conduct of the war. No small part of General Marshall's success in his office was his ability to work successfully with the great number of engineers who were connected with the division either as temporary officers in the army or in a civilian capacity.

Commerce Commission Needs Valuation Engineers

The United States Civil Service Commission states that the Interstate Commerce Commission is making every effort to expedite the valuation of common carriers. The importance of hurrying this work is emphasized, in view of the law which provided for the return of transportation properties to private control and which specifies that the Interstate Commerce Commission shall adjust rates so as to insure a fair return upon the aggregate value of the railway property of carriers, the basis being the valuation made by the Commission.

The office technical force of the Commission is now engaged in the computation and assembly of the large amount of data furnished by the field engineers. For this office work the Commission needs architects and engineers (civil, mechanical, electrical, structural, signal, telegraph and telephone). Senior architects and engineers are offered entrance salaries from $2,100 to $2,700 a year; junior engineers, $720 to $1,920; junior architects, $1,320 to $1,920. Rodmen and chainmen at $720 to $1,080 will also be appointed in the field and office forces. Employees are given a daily allowance for subsistence, as well as transportation expenses, when away on official business, and are also allowed the increase of $20 a month granted by Congress. The Civil Service Commission will receive applications for these positions until further notice.

North Carolina Has Substantial Road Program

Five hundred and eight miles of gravel and hard surface roads, representing an outlay of $7,327,823.58 have been completed or are under construction by the North Carolina Highway Commission, according to figures given out by Frank Page, chairman of the commission. The figures include expenditures for bridges along the various roads under construction. The total mileage of highways is divided among 73 projects in more than half the counties and represents work accomplished since the re-organization of the commission in 1919, the only exceptions being one bridge in Mecklenburg county and two or three minor stretches of road. The average cost per mile for the 127.2 mi. of hard surface road under construction or contact is $31,468, and for the gravel roads $8,495 per mile.

Electrification of Swedish State Railways

According to recent statement in Commerce Reports, the Swedish Parliament has now definitely approved the electrification of the state railways between Stockholm and Goteborg, and has appropriated 23,000,000 krone (normally $1,164,000). It is expected that the work will be completed by 1925.

To Complete Subway Contract By Force Account

Following the abandonment of work on the Eastern Parkway subway route in Brooklyn, New York City, by the Inter-Continental Construction Corporation on July 1, 1920, the city's Board of Estimate has just authorized the Transit Construction Commissioner to complete the contract by force account. The work is nearly completed, and by resorting to force account work it will be possible to open the line to traffic before a new contract could be advertised and let. The line is expected to be opened for service in about four months.

Minnesota Cities Would Develop Water Power

The Municipal Electric Corporation, representing the municipalities of Minneapolis and St. Paul and the University of Minnesota, will apply to the national waterpower commission for priority of license to utilize the power generated at the Federal High Dam in the Mississippi River between the two cities. Application will be filed as soon as the Federal Power Commission is organized.

According to estimates of engineers, the dam will develop between 15,000 and 20,000 hp. It is held by those seeking control and utilization of this power by the public that it would supply all the needs of the state university, located in Minneapolis, and serve municipal works in Minneapolis and St. Paul as well.

Mayor L. C. Hodgson of St. Paul is chairman of the Municipal Electric Corporation, Mayor J. E. Meyers of Minneapolis is secretary and Fred B. Snyder, of Minneapolis, president of the board of regents of the University of Minnesota, is the third member.

If the national commission grants the license requested, as against possible like requests from private power companies, the municipal corporation will erect a power plant at the dam and arrange for distributing the power.

Settle First Rail Claim Winding Up Federal Operation

The first settlement with a railroad company covering all claims as a result of Federal operation has been announced by the Railroad Administration as the agreement to pay the Spokane, Portland & Seattle R.R. $1,600,000 in cash as the sum remaining after balancing accounts. Nearly 500 claims remain to be settled, and it is the belief of Railroad Administration officials that most of them will be made on the lump-sum basis after balancing conflicting claims. The claims of some companies amount to $10,000,000 or $12,000,000. No attempt has been made to estimate the amount which will finally be paid to wind up all of the affairs of the Railroad Administration or the length of time that will be necessary.

Women Organize National Engineering Society

The American Society of Wom Engineers and Architects has b organized with a view to the prof sional improvement of its members a the general advancement of women i engineering and architecture. Th officers are: Lou Alta Melton, Boulde Col., president; Hilda Counts, Pitt burgh, vice-president; and Hazel Quick, Detroit, secretary-treasure Social intercourse among members is to be encouraged. These results are to be accomplished by the publication of such papers, discussions and communications as may seem to be expedient, and by personal letters. An official publication is to be maintained.

The primary reason for organization of the society, as explained by Miss Quick to *Engineering News-Record*'s representative, grew out of the fact that the organizers felt the need of a society and were not received into the existing societies organized for and by men in the engineering profession.

The organization was started by correspondence in December, 1918, and the society was formally organized in February of this year. The preliminary work of getting together information for the organization was done by the women engineers of the University of Colorado. All universities and colleges having engineering departments were canvassed by mail and the names and addresses of women engineering graduates and students were obtained. It was found that about 200 women are now engaged in the field of engineering and architecture.

Qualifications for membership at present are such as to admit both college graduates and non-graduates who have a certain specified amount of engineering or architectural experience. Women who have been in active practice for at least two years are eligible for membership, one year's credit in an engineering college of recognized standing being considered equivalent to one-half year's actual experience. A woman who is a graduate, a senior or a junior student in a school of engineering or architecture of recognized standing is considered eligible for membership.

The society now has eleven members working in the following branches of engineering: Three in civil, three in electrical, two in mechanical, one in chemical and two in architectural engineering. They represent the universities of Colorado, Michigan, Kentucky, Kansas, Cornell, Ohio and Armour Institute of Technology. As the membership increases it is planned to form local chapters and to hold regular meetings.

Vote on Interest Rate Increase for California Road Bonds

Returns on the initiative petition of July 14 to raise the interest rate on the highway bonds of the State of California, in order to make them salable.

indicate, according to a telegram received from A. B. Fletcher, state highway engineer, that more than 75,000 voters have approved the proposed measure. The California law requires only 55,000 names on petitions of this sort. Mr. Fletcher states also that time extensions secured in many counties may result in adding enough signatures to the petition to bring the total number to double that legally required.

Advisory Council to Mapping Board Is Organized

Organization of the advisory council to the Board of Surveys and Maps, was completed at a meeting in Washington, July 12. The executive committee of the advisory council is to consist of Dr. E. B. Mathews, Division of Geology and Geography, National Research Council, chairman; A. G. Seiler, American Automobile Association, secretary; William A. Nelson, president of the Association of State Geologists; A. Stuart Baldwin, vice-president, Illinois Central Railroad; J. H. Milburn, office engineer, Baltimore & Ohio Railroad. Additional members were assigned to committees as follows: Co-operaiton, Dr. George Ashley, State Geologist of Pennsylvania and A. D. Flinn, secretary, Engineering Council; technical standards, George S. Hosmer, Massachusetts Institute of Technology; topographic maps, W. W. Atwood, president, Clarke University, and Isaiah Bowman, American Geographic Society; highway maps, W. O. Hotchkiss, State Geologist of Wisconsin and A. G. Seiler, American Automobile Association; general maps, A. B. Hoen, Baltimore, Md., and W. P. Northrup, Buffalo (representing commercial map makers); control, J. F. Hayford, Northwestern University; information, P. Lee Phillips, Library of Congress.

The Board of Surveys and Maps and its advisory committee expect to continue work actively during the summer. Reports will be submitted at a general meeting which will be held in Washington September 14.

A Chance to Buy a Concrete Ship

The United States Shipping Board is asking for sealed proposals for the purchase of the concrete steamship "Polias" which lies on a jagged rock off Penobscot Bay in Maine. Sealed proposals will be received at the office of the Shipping Board in Washington until July 20 for the purchase of the above steamer on a lump-sum basis "as is, where is." The vessel was stranded on Old Gilley Ledge, off the coast of Maine, on Feb. 6, 1920, as described in *Engineering News-Record*, March 4, 1920, p. 483. The sale includes certain nautical instruments and equipment in possession of the Coast Guard Station near the scene of the wreck. Bidders must include in the offer an agreement to dispose of wreckage. The terms of payment are cash on acceptance of the offer and a certified check for 10 per cent of the offer must accompany the bid.

Latest reports from the ship are that it has moved little, if any, since it struck the rock. It is about five miles out to sea, but easily accessible in ordinary weather. The reports that were made right after the wreck were that the bottom was badly ripped, but that the frame was intact. The "Polias" was built by the United States Emergency Fleet Corporation at Flushing Bay, Long Island, N. Y., and was launched about a year and two months ago.

Electrification of Swiss Railways

As a "part of a program for the gradual electrification of the government railway system of Switzerland," a syndicate of New York bankers recently offered $25,000,000 of Government of Switzerland twenty-year 8 per cent bonds at par, the entire proceeds of which are to be spent in the United States. The circular issued by the syndicate states that Switzerland has estimated water power resources of 2,700,000 hp. and that the progressive utilization of this power will effect large economies by substituting hydro-electric power for fuel which Switzerland now must buy at high prices.

A. A. E. Activities

The Cleveland Chapter has elected the following officers for the year 1920-21: President, William P. Blair: vice-president, C. I. Long: secretary, T. J. Brennan: treasurer, Ben Davies.

The San Francisco Chapter, in a report on the California State Civil Service, recommends that all engineering positions be freed from statutory limitations as to salary and that all engineers, excepting chief administrative officers, be placed under civil service. Minimum salaries were advocated as follows: Junior engineer, $1,800; assistant engineer, $2,400; senior assistant engineer, $4,000; engineer, $5,000. No limit was placed for salaries of chief engineers.

A chapter has been organized at Honolulu, T. H., the president of which is John H. Wilson, mayor of Honolulu, and vice-president, Lyman H. Bigelow superintendent of public works and chairman of the board of harbor commissioners of the Territory of Hawaii. The chapter was organized by J. L. Young, consulting engineer and contractor, Honolulu. George M. Collins is secretary.

The Executive Committee of the Association has requested chapters in states bordering on the Great Lakes and the Canadian Border to urge upon the President of the United States and United States Senators the desirability of appointing an engineer to the vacancy on the International Commission.

Civil Service Examinations

United States

For the United States civil service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission, for Form 1312.

Engineer Examiner, Class A, $3,900 to $4,800 a year. Applications should be filed without delay.

Engineer Examiner, Class B, $2,220 to $3,600 a year. Applications should be filed without delay.

Highway Engineer, $2,100 to $2,700 a year. Bureau of Public Roads, Department of Agriculture. Applications should be filed not later than Sept. 9.

Junior Engineer, Grade 1, $1,500 to $1,920 a year. Applications received until further notice.

Engineer, $2,400, or over, a year.

Assistant Engineer, $1,800 to $2,340 a year.

Junior Engineer, $1,440 to $1,740 a year.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Portland, Ore., Aug. 10-12.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Sept. 13-17.

The American Wood Preservers' Association will hold its seventeenth annual meeting in San Francisco Jan. 25-27, 1921. It will be the first convention of the association held west of the Mississippi River. The annual convention of the National Association of Railroad Tie Producers will also be held in San Francisco the same week. The plans being made by the various association committees include a special train, via the Santa Fe; a meeting with the southern California engineers and wood users in Los Angeles on Jan. 24; a joint dinner and meeting with San Francisco engineers and lumbermen on the evening of Jan. 25, and meetings in Portland and Seattle following the convention. Trips are planned also to lumber yards, waterfront structures, mills, treating plants, logging camps and into the Redwood and Douglas fir timber.

American Concrete Institute.—An innovation in the American Concrete Institute was a sectional meeting held in New York City on July 16. This meeting, which was called by President H. C. Turner, was on the subject of shear in concrete and was addressed mainly by W. A. Slater of the U. S. Bureau of Standards, who described a number of the tests on especially designed beams

for the Concrete Ship Section of the Emergency Fleet Corporation in which special attention was paid to the investigation of shear strength. The meeting was very largely attended, not only by members of the Institute, but by other New York engineers who were notified in advance.

The Iowa Engineering Society has voted favorably on the adoption of a new constitution which would include as members all existing local organizations. The vote was 173 for and 7 against, out of a membership of 350. Thus far no local club has taken action on the matter, although some of them have the proposition under consideration by committees. Action is not looked for until fall.

PERSONAL NOTES

T. S. BOND, assistant engineer of the International & Great Northern R.R., with headquarters at Palestine, Tex., has been appointed chief engineer, with same headquarters.

M. M. BUCK has resigned as road engineer of Ottawa County, Mich., to engage in private practice. He will be succeeded by GEORGE BORCK, of Grand Haven, Mich.

B. S. VOORHEES district engineer, New York Central R.R., has been promoted to the position of general office engineer, New York Central Lines, on the staff of George A. Harwood, assistant to the president.

W. E. HOLLAND has resigned from the Central Foundry Co., Chicago, and will engage in waterworks construction under the firm name of Cole & Holland, South Bend, Ind.

H. W. ALDEN, of Detroit, past-president of the Society of Automotive Engineers, has been designated as the representative of that society on the Federal Highway Council committee on transportation and committee on subgrade in relation to road surfacing.

KASTENHUBER & ANDERSON, civil engineers and surveyors, of Easton, Md., announce the withdrawal of John Anderson from that firm. Edwin G. Kastenhuber, Jr., will continue business under the present firm name of Kastenhuber & Anderson. Mr. Anderson has taken up work as an instructor at the Citadel, Charleston, S. C.

W. G. WORDEN has resigned as town engineer of Oshawa, Ont., and has been engaged by the board of water commissioners as superintendent of water-works.

JOHN BERG has been appointed state engineer of South Dakota to succeed Homer M. Derr, resigned. Mr. Berg has been deputy state engineer during the past year.

THE W. B. ROLLINS ENGINEERING CO., Kansas City, Mo., will hereafter conduct the business of W. B. Rollins & Co. One of the new members of the company is Robert H. Hammond, recently county highway engineer in Southern Iowa. The other member is F. H. Frauens, Jr., who has been connected with the firm since 1914.

G. H. EDGECOMBE, Ottawa, Ont., has been nominated as surveyor for forest resources for the Canadian Commission of Conservation.

C. L. SPAULDING has been appointed district engineer, Eastern District, New York Central R.R. This district has been extended to include the electric zone, exclusive of the Grand Central Terminal.

C. N. CAMPBELL has been appointed assistant valuation engineer, Southern Pacific, Texas and Louisiana Lines, with headquarters at Houston, Tex.

F. H. MURRAY, state highway engineer of South Carolina, has resigned to enter private practice with J. Roy Pennell, former state highway engineer. Mr. Murray has been succeeded by Charles H. Moorefield, formerly district engineer with the U. S. Bureau of Public Roads.

WILLIAM D. ENNIS has resigned as professor of marine and mechanical engineering in the post-graduate department of the U. S. Naval academy, to become vice-president of the Technical Advisory Corporation of New York. Mr. Ennis has been associated with the latter corporation since its organization and will be hereafter located at its general offices, in New York City.

HUNTINGTON SMITH has been appointed office engineer of the New York, Chicago & St. Louis Railroad Co. at Cleveland, in place of J. W. Wilkinson, deceased; C. R. WRIGHT has been appointed division engineer between Painesville and Bellevue, with headquarters in Cleveland, succeeding Mr. Smith; HERMAN KOCH has been appointed supervisor of bridges and buildings, Buffalo and Cleveland divisions, with headquarters at Conneaut, Ohio, succeeding H. H. Oppelt, retired, and WILSON SPRAGUE, who has been on leave of absence, has resumed his duties as division engineer between Buffalo and Painesville, with headquarters at Conneaut.

HARVEY C. ROSE has been appointed resident engineer, with headquarters at Guelph, Ont., in connection with the construction of Provincial highways in western Ontario.

R. H. MURRAY, engineer of the Bureau of Public Health of Saskatchewan, has been appointed director of the newly organized Division of Sanitation of the Bureau.

EDMUNDS WILKES, for several years connected with the Interstate Commerce Commission as senior engineer, and also with the bridge department of the Kansas City Terminal Railway Co., has opened an office as structural engineer, 706 Mutual Building, Kansas City, Mo.

BUSINESS NOTES

WILLIAM F. HARVEY, formerly in charge of the Chicago territory for the Truscon Laboratories, has taken a position as sales manager with the Viscous Paint Oil Co., Chicago.

O. P. CHERDRON, former president and founder of the Lynch Cannon Engineering Co., has sold out his interest in that company and formed the Cherdron Construction Co., with headquarters in Salt Lake City. The Cherdron Co. will handle all kinds of industrial work, office buildings, hotels, etc.

Shuveloder Has Adaptability for General Contracting

A mechanical material handler primarily designed for use in mining work, but which may be used by general contractors in loading muck in tunnels and cuts is the "shuveloder," shown in the accompanying illustration. The shuveloder, built by the Lake Superior Loading Co., Duluth, Minn., is a compressed-air operated machine, comprising three main elements: A truck with wheels suiting the gage of the track; a platform or turntable providing lateral movement to the shovel; and a body member containing the operating cylinder and shovel guide members in which the shovel and its arm function.

NEW MUCK HANDLING MACHINE

The body piece consists of four cast-iorn cylinders and their pistons; three operating valves; and a crosshead which travels in horizontal guides and carries the rope sheaves to which are fulcrumed the dipper arms and the dipper. The shuveloder is not of the continuous-operation or cycle type, but each motion has a separate control that is reversible. The digging and loading movements are performed by the action of compressed air upon direct pistons and require no gears, chains, clutches, belts, conveyors nor engines.

The length of the shuveloder is 6 ft. and its overall width and height 4 ft. It has a wheelbase of 19½ in., a dipper width of 30 in., and the contents of the dipper are 4.45 cu.ft. It weighs approximately 4,300 lb. and is rated at a capacity of 45 tons per hour.